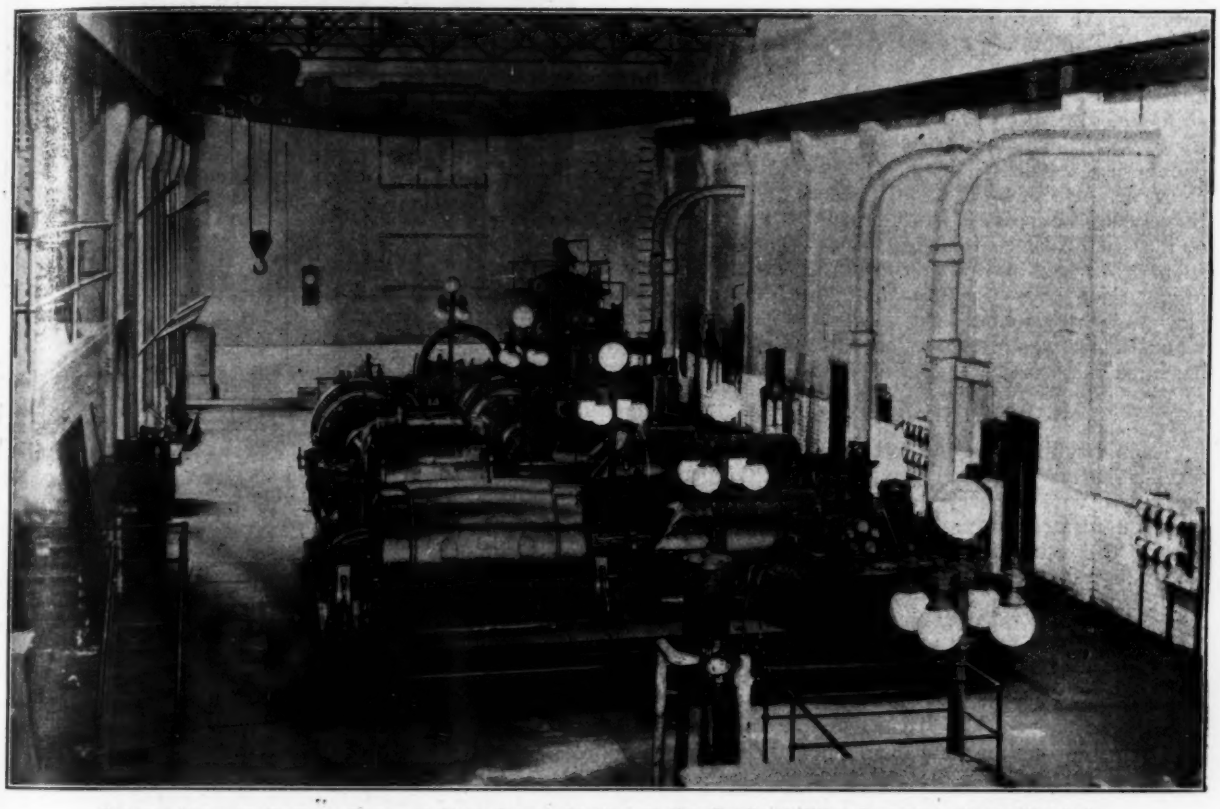
Electrical Review

With Which Is Consolidated WESTERN ELECTRICIAN and ELECTROCRAFT.

VOL. 71—No. 15. CHICAGO, SATURDAY, OCTOBER 13, 1917. PAGE 625.



General View in Turbine Room of Main Power Station of the Public Utilities Company, Evansville, Ind.

Changing From 2300 to 4000 Volts Without Interruption to Service

Public Utilities Company, of Evansville, Ind., Accomplishes Feat in an Interesting Manner—Details of Power Station and Distribution System

CHANGING over a complex distribution system from 2300 to 4000-volt generation without interruption to service, or without a single mishap, is an achievement of which the Public Utilities Company, of Evansville, Ind., is justly proud. Under the conditions existing before the change, the task was one of great magnitude and involved a great deal of thought and preparation on the part of Superintendent of Construction B. V. Bosard and his assistants. That there was practically no interruption in service and that not a single injury or accident occurred, reflects great credit on the ability and resourcefulness of the utility organization.

Before describing in detail the methods employed in making the change, it may be of interest to explain briefly some of the conditions which led to the decision to abandon the 2300-volt system.

GROWTH OF EVANSVILLE COMPANY

The Public Utilities Company supplies light, heat and power to about 6500 customers in Evansville, a city of 100,000 population, in the southern part of Indiana, and also service to a number of smaller surrounding towns, including Haubstadt, Fort Branch, Winslow and Inglefield. In addition the company also supplies energy to three electric railways with an aggregate load of about 1300 kilovolt-amperes.

In Evansville the company has a number of im-

portant power customers and also furnishes energy for street lighting amounting to 500 kilowatts. This load is fed from constant-current transformers, eight in number, divided among the three phases so as to connect one side of each transformer to the neutral wire and the other to one of the phases.

The most important power customers are seven coal mines, having an aggregate load of several thousand kilowatts, and the Hercules Buggy Company with a total connected load of 1000 kilowatts.

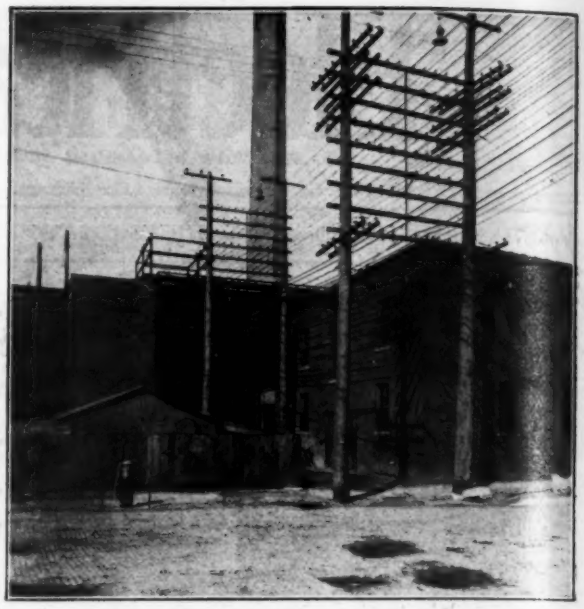
The business of the company has been steadily increasing and a number of years ago it was found necessary to plan something to increase the capacity of the distribution system. At that time it was decided, after a careful analysis of the situation, to change over from 2300-volt three-wire to 4000-volt four-wire operation and as it meant only the running of one additional wire over the system, the necessary copper was installed. This work was done gradually, construction crews being assigned to the work when they could be spared from other duties. However, owing to the lack of station capacity, insufficient insulated busbars, and other conditions, the actual work of changing over was prevented until fall when the new 4000-volt switchboard was completed. The previous board was destroyed by fire and this greatly hastened the work.

Methods of Changing Over.

Each circuit was gone over in its entirety and all three-transformer power banks were equipped with the fourth wire but were left connected in delta. The two-transformer power banks were arranged so that one of the primaries was connected to the neutral. Each single-phase lighting transformer was connected so that one primary wire was attached to the neutral and the other to one of the three-phase wires. The 2300-volt system was being operated with four wires, the neutral and one phase being connected together and in all respects making one wire.

The scheme of line construction in Evansville had been thoroughly gone over when the fourth wire was first installed and the following scheme of phase relation was followed out on the poles. The neutral wire was placed on a pole pin, phase *A*, *B* and *C* following in order out to the end of the arm, and, as indicated before, the pole pin and phase *C* on the end of the arm were connected together as one phase.

Light and Power Circuits Leaving Generating Station on Steel Structure.



Another Group of Circuits Leaving Station.

In connecting the single-phase transformers in getting ready for the cutting over, it was necessary to balance one of the phases by placing transformers between phases *A* and *B*. These transformers were made note of, so they could receive attention when the circuit was put into 4000-volt operation.

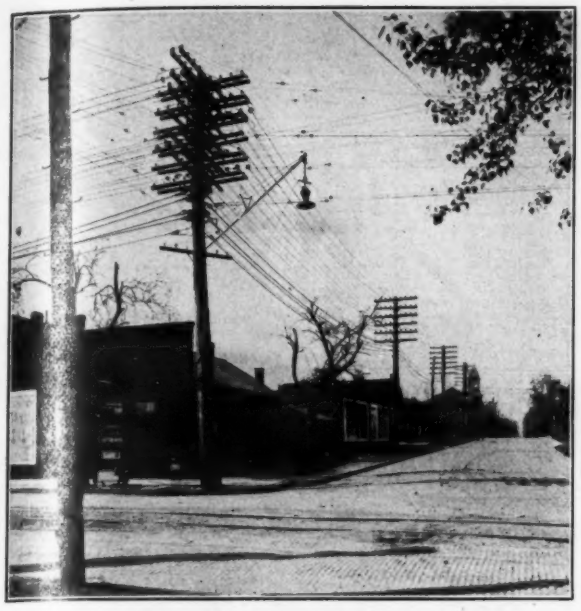
It was decided that Sunday would be the best time to change over and the company sent out three or four crews with instructions to go to all power banks and pull out the primary fuse plugs, and also to pull the plugs on those transformers connected between phases *A* and *B*, as mentioned before. As soon as the crews did their allotted work, they telephoned the plant and reported to the operator. When all crews had reported, the circuit was cut off from the 2300-volt supply and connected to the 4000-volt switchboard, and immediately put into service again. This work required only a few minutes as all that was necessary was to cut off three 2300-volt tap wires and close the four disconnecting switches on the new line. Fifteen minutes was the longest time the whole circuit was off.

The waiting crews were in the meantime making the changes on all power banks, changing the connection from delta to star, and were notified by messenger when the circuit was made "hot" on 4000 volts. In this way power consumers were only shut off for an hour and a half or two hours at the most, most cases being less than an hour. Some of the lighting circuits had very little power on them and these were cut over on week days, in sections, by cutting parts of the circuit onto a parallel or adjoining circuit.

The 2300-volt distribution system was so heavily loaded that all circuits were operated tied together at outlying points, and this condition, while not ideal for operating, worked to very good advantage in cutting over.

It required about five weeks to make all of the changes and the work was done without an accident to a single person, and with the loss of but three small transformers, one of which was left across the 4000-volt phase wires on a lighting unit and the other two in a power bank in the same manner, all three of them having been overlooked in some way or other.

Since the system has been in operation on 4000



Important Corner Pole of Overhead Distribution System.

volts the results have been very satisfactory, constant voltage being secured throughout the entire 24 hours.

The present system constitutes twelve 4000-volt four-wire, three-phase circuits, eight of which are for lighting, two exclusively for power and two for power and lighting. The three phases of the lighting circuits are carried out only to the distributing centers and from there they are split into 2300-volt single-phase sections. The power circuits are four-wire throughout their entire length.

Numerous disconnecting switches are located at convenient points on the feeder circuits, thus making it possible to feed sections of certain lines through sections of other parallel lines in the downtown district in case of trouble. This sectionalizes the system so that any trouble that may occur can be localized.

Details of Power Plant.

Division Street power station of the Public Utilities Company is by far the largest generating plant in Evansville. It supplies electrical energy for the street railways, interurban lines, city lighting and commercial light and power. The station capacity is 10,250 kilowatts and the load runs as high as 7500 kilowatts. Current is generated at 4000 volts three-phase with the neutral grounded. For the feeders to the interurban rotary-converter substations, the voltage is stepped up to 13,000 and 22,000 volts. The street railways are supplied through motor-generator sets in the power plant.

The station contains five generator units. The first machines installed were two Curtis vertical turbines rated at 750 and 1000 kilowatts, respectively; then a 1500-kilowatt Allis-Chalmers turbine and finally two Westinghouse double-flow turbogenerators, one of 2000 and the other of 5000 kilowatts capacity, were installed. The smallest vertical turbine is served by a jet condenser, the other units being equipped with surface condensers. With the exception of the vacuum pumps, the auxiliaries are motor-driven, plenty of exhaust steam for the feed water having been available from fourteen 12 by 36-inch deep-well pumps supplying circulating water for the condensers. Exhaust is also obtained from the vacuum pumps, two of four exciter sets serving the station and the boiler-feed pumps.

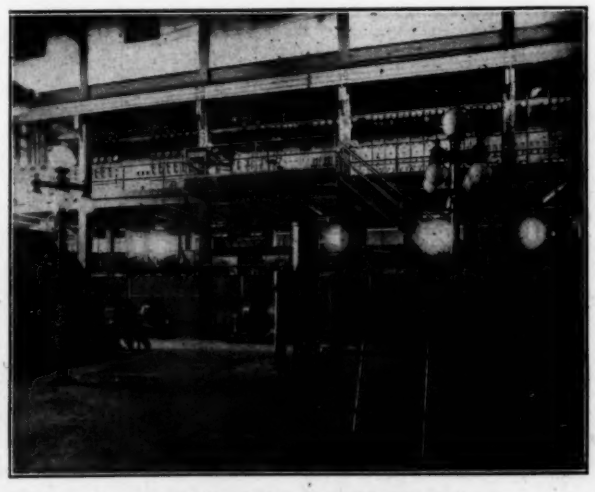
The supply of cooling water has been conserved by the use of cooling towers. Owing to excessive corrosion caused by the well water, it was decided to run a 36-inch line to the river and pump a sufficient supply to the plant for condenser cooling, boiler makeup water, as before, to be taken from the city mains. In a well at the river, 32 feet diameter by 60 feet deep, two 16-inch centrifugal pumps, each having a capacity of 7500 gallons per minute were installed. The pumps are driven by 150-horsepower motors controlled from the power plant. From the river to the well there are two 36-inch intakes, each equipped with two 32-inch Liberty strainers, the duplication allowing one to be cleaned while the other is in operation.

In the boiler room there are eight water-tube boilers having an aggregate capacity of 3660 horsepower, made up of four 515-horsepower Babcock & Wilcox, two 450-horsepower and two 350-horsepower Aultman & Taylor boilers. Eventually there will be six more boilers of 515-horsepower capacity each. All are served by Babcock & Wilcox chain grates, and natural draft is supplied by two concrete stacks, one rising 215 feet and the other 200 feet above the grates. All boilers have three gas passes formed by vertical baffles, operate at 210-pound pressure and 100 degrees of superheat and are equipped with General Electric steam flow meters, Mason damper regulators and Bristol thermometers recording the temperature of the flue gases.

From bottom-dump railway cars coal for the plant is discharged into concrete track hoppers provided with gates through which the coal passes into industrial cars. These cars are elevated 51 feet by a hydraulic elevator having a 12-inch ram and are pushed out over and dumped into individual 20-ton steel bunkers serving the boilers. Underneath, each boiler has fine-coal, ash and soot hoppers, the last-named being under the rear combustion chamber. All are served by the industrial cars. The ashes and soot are elevated into a large steel bunker discharging into railway cars or into wagons. The fine coal is returned to the bunkers.

Switching Equipment.

Of special interest in the plant is a new switchboard, one of the Westinghouse company's latest productions, equipped with a full complement of the most modern instruments and operating devices. The board and all related switching and control apparatus take up



General View of Main Switchboard.

View Behind Switchboard.

Another View Behind Board—Oil Switches at Left.

three floors and the basement. There are two main buses that may be operated in parallel or separately, and three sets of auxiliary buses. If desired, it would be possible to run each generating unit separately, and one of the auxiliary buses could be cut in for either service or all three could be thrown together and relieve the main buses entirely. It is the custom to inspect all oil switches every three months, and at this time or in case of trouble it is an easy matter to transfer the circuit to one of the auxiliary buses and cut out the switch on which it is desired to work. It is thus evident that almost any combination is possible and that the board is unusually flexible. It is electrically controlled throughout. In each circuit there are four oil switches—one in each phase and one in the neutral. Each switch is in an individual concrete compartment sealed by an asbestos door that is easily removable. The switches are solenoid-operated, with remote control from the board on the first balcony. The field rheostats are electrically controlled, the power circuits are equipped with automatic regulators, and time-element overload relays of the latest type protect the generators. All city current is sent out of the station at 4000 volts.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES.

Opening Address by Colin G. Fink of the Chile Exploration Research Laboratories.

The opening address at the National Exposition of Chemical Industries, New York City, September 24, 1917, was delivered by Colin G. Fink, Ph. D., formerly with the General Electric Company, and now managing director of the Research Laboratories of the Chile Exploration Company, New York. His address, in part, is as follows:

It was certainly a propitious moment when three years ago Mr. Roth, Mr. Nagelvoort and Mr. Payne suggested and planned the first chemical exposition.

Never before in the history of electrochemistry has the importance of the various electrochemical products been so forcibly brought to the attention of our government and of our people as in the present year of the great war. Take from this country its electrochemical industry, with its diversified manufactures, and the martial strength of our country would be hopelessly crippled. Think of the hundreds of machine shops that are utterly dependent upon the electrochemical abrasives, corborundum and alundum; think of the thousands of rifles and guns turned out every month with the aid of high-speed steel made from electric fello alloys; think of the millions of pounds of electrolytic copper absolutely essential for our telephone, wireless and other electrical apparatus. There is the aeroplane, whose light, strong stays are made from the electrochemical metals aluminum and magnesium; there is liquid chlorine, a product of the electrolytic cell, and the basis of the Carrel-Dakin method of treating the wounds of our heroes; there is electrolytic hydrogen, used in all of our scout and observation balloons, and there are the numberless electric alloys entering into the composition of nearly every item of the government's military equipment.

An interesting feature of the electrochemical industry is its American origin and its present international scope—international in the sense that the industry is not restricted to one or two countries or localities. Take, for example, the calcium carbide industry. This was founded by an American, Thomas Willson; and within a generation it has grown by leaps and bounds. Today there are large carbide factories in almost every country of the world. Compare with this the sulphur industry, confined to the United States and Italy; or the petroleum industry, confined to the United States and Russia. The natural saltpeter industry is confined to Chile; but the electrochemical saltpeter industry, founded by Bradley and Lovejoy at Niagara Falls, has spread to every important civilized center.

Wherever low-priced water power or low-priced fuel is available in generous and steady amounts, there electrochemical factories will be established. Our country has been foremost in the electrochemical industry ever since its inception, due to American genius on the one hand and to our vast natural resources on the other. May we continue to lead the world in the supply of electrochemical products, pure metals and alloys for the arts, gases for cutting and welding, chlorine and peroxides for our hospitals, chlorates and acetones for munitions, nitrates for the farm and defense, abrasives, electrodes, solvents and lubricants. May we continue to excel in the products of the electric furnace and in the products of the electrolytic cell.

Electrification of the Union Iron Works Plants

Details of Substation Equipment and Lighting and Power Installation at Mammoth San Francisco Shipbuilding Plant—Central-Station Service Employed

THE Union Iron Works, San Francisco, for years has taken the lead in the shipbuilding industry on the Pacific Coast. Its construction work in this line embraces the building of naval ships of all sizes and classes, cargo vessels for over-sea and coastwise service, and extends to that of harbor and gold-mining dredges for the American continent and the Orient; a heavy business in ship-repairing is carried on, as well as structural and iron work in other industries. The ships referred to are all of steel construction.

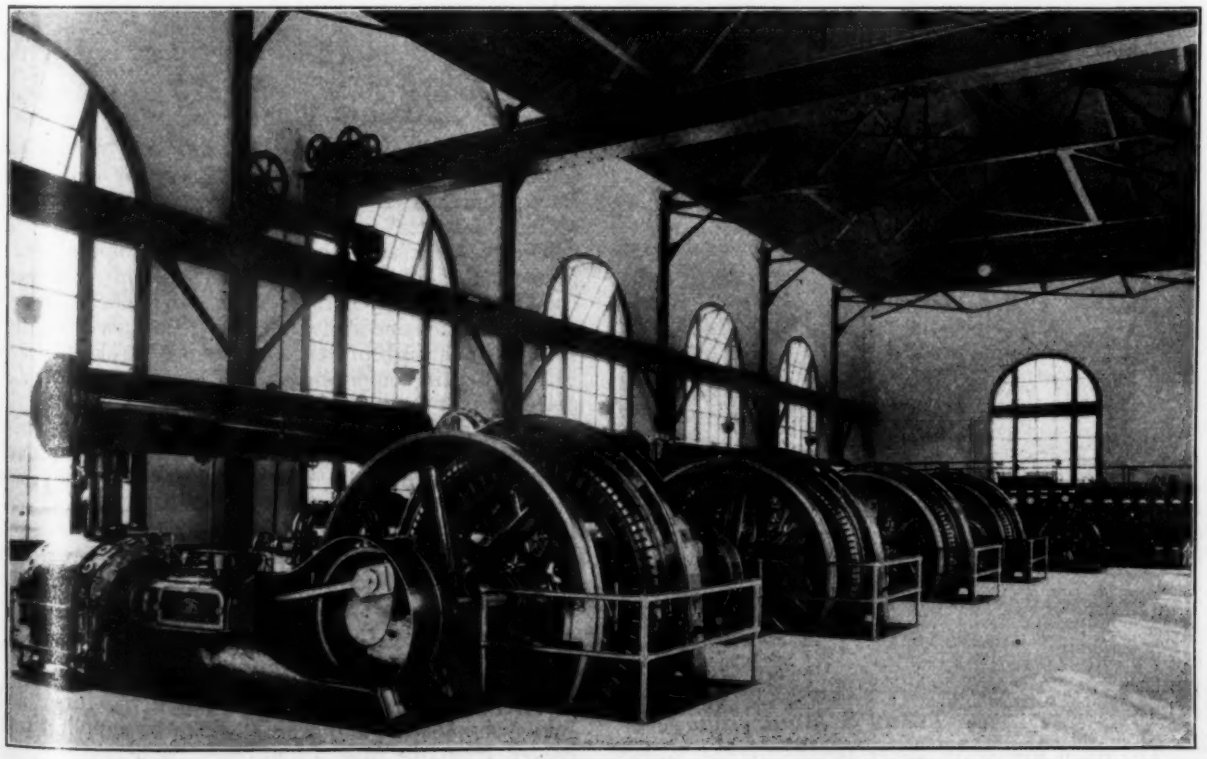
These works, controlled by the Bethlehem Steel Corporation, comprise three plants, advantageously situated on San Francisco Bay, in which over 8,000 men are employed. One is at Alameda, on the opposite shore of the bay from San Francisco. During the last four years their shipbuilding facilities have been increased to meet the requirements of the gigantic scale of construction now in full swing. These improvements extended to shipbuilding slips, floating dry docks, graving dock, shop equipment and marine railways.

Electrical Installations.

The most interesting feature of these works to readers of Electrical Review is that pertaining to the use of electric energy and the equipment utilized in applying it. The facts concerning substations, distributing system, protection and control, motors and methods of connecting, crane equipment, lighting, and yard transportation are herein given, under separate headings.

Utility Company Service.

The electric power is supplied to the several plants and load centers by the Pacific Gas & Electric Company, whose transmission lines have been extended from its numerous steam-electric and hydroelectric power houses to serve the entire central area of California. Power for Union Iron Works is furnished at a uniform potential of 11,000 volts, three-phase, 60-cycles, and is transformed to suitable voltages, both alternating and direct current, in substation located near the load centers in the different plants. It is metered on the secondary side of the transformers, and the following voltages have been standardized: 230 volts for direct current power; 480 volts, three-phase, for alternating current power; 208 volts, three-phase, four-wire, for lighting, permitting operation of lights at 120 volts to neutral, and 220-volt, three-phase portable motors onboard ship, where the use of 440-volt portable wiring would be dangerous. On account of the superior flexibility of control obtainable, direct-current motors are used on all ma-



Direct-Connected Air Compressors and Rotaries in 20th and Michigan Power House, Potrero Plant.

chine-shop tools that operate at variable speed, and all other motors are alternating current.

Substations and Their Location.

There are seven centers for the distribution of electric current, requiring the operation of substations, situated as follows: Potrero Works, station at 20th and Michigan; for Potrero Works, at 18th and Illinois; Potrero Works, dock-pumping station; Alameda plant, shipyard station; Alameda machine shop station; Hunter's Point dock, pumping station; auxiliary pumping station at same dock. The following description of each of the substations gives an idea of the scope of service required and the equipment employed.

Air Compressor Station.

The 18th and Illinois substation is an air-compressor plant only, and is situated adjacent to the building slips in the Potrero plant. It was completed in March, 1915, and contains four belted compressors as follows: Two 23-inch low-pressure and 14-inch high-pressure by 20-inch stroke Ingersoll-Rand compressors, each operating at a speed of 160 revolutions per minute, and having a piston displacement of 1548 cubic feet of free air per minute. Each compressor is belted to a 300-horsepower induction motor; one 26-inch low-pressure and 16-inch high-pressure by 36-inch stroke Risdon compressor, operating at a speed of 96 revolutions per minute and having a piston displacement of 2114 cubic feet of free air per minute. This compressor is belted to a 500-horsepower induction motor; one 26-inch low-pressure and 15-inch high-pressure by 18-inch stroke Hall compressor, operating at a speed of 118 revolutions per minute, and having a piston displacement of 1305 cubic feet of free air per minute. This compressor is belted to a 250-horsepower induction motor. In addition to the above, a small Ingersoll-Sergeant single-stage machine, geared to a 75-horsepower induction motor, and having a capacity of 400 cubic feet of free air per minute, at 125 revolutions per minute is installed. The transformer equipment at this station consists of three 500 kilovolt-ampere, water-cooled, and three-150 kilovolt-ampere, oil-cooled units, all with a secondary voltage of 480 volts, three-phase.

Cantilever Crane, Potrero Plant. Operated by Three-Phase Induction Motors.

Potrero Plant Station.

The main source of power supply for the Potrero plant is the substation at 20th and Michigan Streets. It was completed in July, 1913, and was the first modern station erected by the company. Its equipment is as follows: Two 200-kilovolt-ampere rotary converters with transformers furnishing 230-volt direct current; three 75-kilovolt-ampere transformers furnishing lighting; three 750-kilovolt-ampere transformers furnishing alternating current power; four 28-inch low-pressure and 17-inch high-pressure by 26-inch-stroke Chicago air compressors, operating at a speed of 138.5 revolutions per minute and having a piston displacement of 2485 cubic feet of free air per minute. Each compressor is direct-connected to a 450-horsepower synchronous motor, with its revolving field mounted on the compressor shaft and operated from the 480-volt alternating current bus. Excitation at 115 volts is furnished by a 75-kilowatt motor-generator set, operating from the same source. An air pressure of 100 pounds is carried.

Dock-Pumping Station.

The equipment of the dock-pumping station, situated at the water front of Potrero plant, comprises the following: Three 200-kilovolt-ampere transformers, furnishing power to the floating dry-dock pump motors; three 75-kilovolt-ampere transformers furnishing lighting current to ships and wharves; two centrifugal pumping units, each having a capacity of 800 gallons per minute against 160-foot head, direct connected to 50-horsepower, 1800 revolutions per minute induction motors. These pumps are controlled automatically by float switches located in the water tower, and furnish salt water for fire protection, yard service, and cooling-water circulation of both air-compressor plants; two 2¼ by 12-inch Dean, duplex hydraulic pumps, geared to 50-horsepower induction motors. These pumps are equipped with magnetic controllers, operated by the hydraulic accumulators, and in conjunction with a similar 150-horsepower triplex unit located in the boiler shop, supply the 1500 pound hydraulic service for the Potrero plant. This station also contains the fuel-oil pumps for the yard supply, and the battery-charging equipment for the electric trucks used around the plant.

Alameda Plant Station.

The supply of power for the shipyards at Alameda comes through a new substation, recently completed. Its equipment is as follows: Two 200-kilovolt-ampere rotary converters and transformers furnishing 230-volt direct current; three 50-kilovolt-ampere transformers for lighting service; six 500-kilovolt-ampere transformers for general power service, floating dry-docks, and marine railways; eight 26-inch low-pressure, 15-inch high-pressure by 18-inch stroke Chicago Pneumatic air compressors, each having a piston displacement of 2212 cubic feet of free air per minute, when operated at 200 revolutions per minute. These machines are driven by 390-horsepower synchronous motors with revolving fields mounted on the compressor shafts, and operated from the 480-volt bus. Excitation at 115 volts is furnished from the 230-volt direct-current source on the three-wire system, the field switches of the compressor motors being double-throw to permit balancing the system; and 100 pounds air pressure is carried.

Machine Shop Station.

The Alameda machine shop, pattern, forge and joiner shops and planing mill are to be supplied with power from the substation here, the equipment for

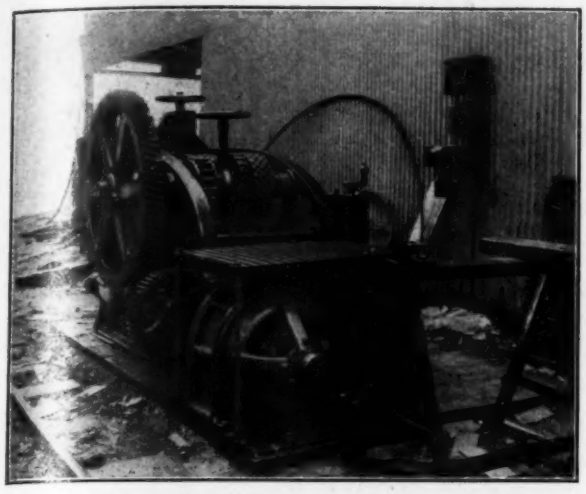


Plate Shed, Potrero Plant. Angle-Iron Planer Operated by 20-Horsepower Alternating Current Motor.

which is to comprise: Three 200-kilovolt-ampere rotary converters and transformers for machine shop power; three 75-kilovolt-ampere transformers for lighting service; four 500-kilovolt-ampere transformers (one spare) for general power service.

Pumping Service at Alameda.

Salt water service for compressor water-jackets and general yard service is furnished by two 20-horsepower contrifugal pumps, located at the water's edge in a small steel building under one of the building slips. Hydraulic service is furnished by two Dean pumps, duplicates of those in the Potrero plant, installed adjacent to the plate shed in the electrical building.

Main Pumping Station.

The power for unwatering the new 1100-foot graving dock will be furnished by the substation at Hunter's Point, which contains three 500-kilovolt-ampere transformers for 2400-volt power service; three 200-kilovolt-ampere transformers for 2400-volt power service; three 200-kilovolt-ampere transformers for 480-volt power service, and three 50-kilovolt-ampere transformers for lighting service.

The pumping equipment required for this work consists of four 48-inch vertical centrifugal pumps, each having a capacity of 75,000 gallons per minute at 43-foot head, direct-connected to a 750-horsepower, 2200-volt induction motor, of 250 revolutions per minute; two 18-inch vertical centrifugal pumps, each having a capacity of 5000 gallons per minute, at 43-62 foot head, direct-connected to a 100-horsepower, 2200-volt induction motor, at 600 revolutions per minute. The use of 2400 volts for the main pumping service is the only departure from the standard voltage of 480, and the change was made on account of the heavy switch gear and cables necessary for motors of this size at the lower voltage. In addition to the unwatering pumps, this station furnishes lighting and 480-volt power service to the entire dock property for capstans, cranes and winches, and for pumps and electrically operated valves in the dock caissons.

Auxiliary Station.

Power for pumps used in unwatering No. 2 graving dock, and for air compressors in dock service, transformers for ship-lighting, and alternating current for tools used in dock work, is supplied from an auxiliary substation at Hunter's Point, which contains the following equipment: Three 100-kilovolt-ampere transformers; three 50-kilovolt-ampere lighting transformers; one 1200-cubic foot Ingersoll-Rand compressor, belted to a 200-horsepower induction motor; one 125-cubic foot Chicago Pneumatic compressor, belted to a 30-horsepower induction motor; three W. T. Garratt centrifugal pumps, rope-driven from Reynolds Corliss engines. These pumps are to be direct-connected to induction motors, the rope drives and engines to be removed to make room for additional air compressor capacity and transformers. This station will carry all load imposed by extensions to the machine tool and shop equipment of the dock, owing to the remote location of the main station on the north side of the property. The location, while ideal for the pumping plant, is, on account of the necessity of carrying cables around the dock, nearly half a mile distant from the rest of the property, and therefore too far for economical low-tension distribution.

Distributing System.

All power from the various stations is distributed to shop switchboards by paper-insulated, lead-covered cables, installed in vitrified terra cotta underground conduits. Each department feeder is metered at the station switchboard, and separate day and night records are kept. From the shop switchboards to the various tool services, open mill construction is used; slow-burning weatherproof wire carried on porcelain insulators, supported by steel racks, having given better service than conduit work on account of greater flexibility under constantly changing load conditions.

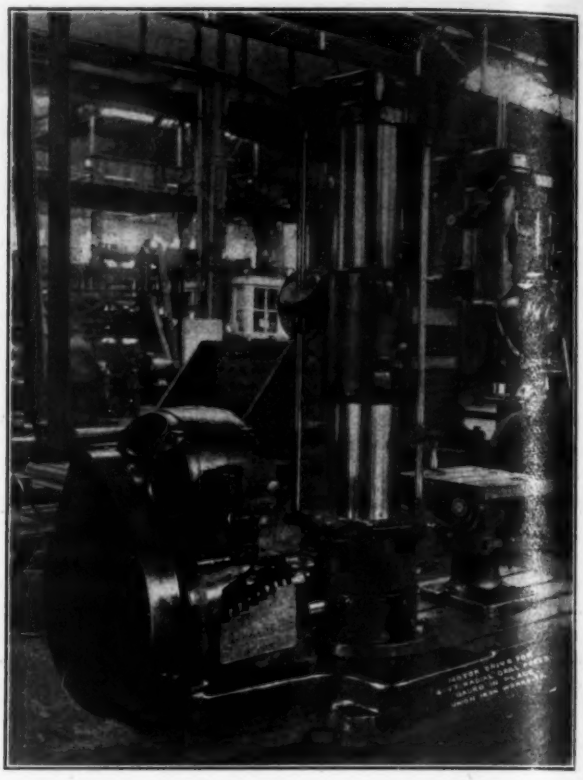
The tool services from the overhead feeders to the motor-control panels are in conduit, all live parts being protected by safety-first enclosed switches and motor-entrance hoods, to prevent accidental contact with live metal. Each tool, together with its motor and control apparatus, is, as far as possible, self-contained, so that when a tool must be moved to accommodate shop changes, the expense is limited to an alteration of the service connections only.

Protection and Control.

Small motors are protected from overload by

Pattern Shop, Potrero Plant. 48-Inch Planer With 15-Horsepower Motor.

Pattern Shop. 40-Inch Band Saw With Belt-Connected Three-Horsepower Alternating Current Motor.



Potrero Machine Shop, Showing Four-foot Radial Drill Direct-Geared to Five-Horsepower Motor.

fuses, but direct-current motors over 10 horsepower, and alternating-current motors over 5 horsepower, are protected by time-limit overload relays, which can be reset without loss of time by the operator in case of overload to the equipment. Automatic control, operated from conveniently located push buttons, is used on practically all tools, except lathes, the automatic controllers of which are operated by master stations connected to levers in the aprons. Dynamic braking is used on all tools where quick stopping of the motor results in a saving of time, and experience has shown that this applies to almost all machine shop tools.

Every tool in the plant is individually motor-driven, and wherever possible, the motor is built into the machine and geared, or direct-connected, to the spindle to eliminate belt slippage with its limitation of output. Adjustable speed motors, with ranges as high as 6:1 are in use, and do away with a great deal of gearing. All gearing is well protected by sheet steel or expanded metal guards to prevent injury to the workmen.

Standard railway trolley material is used on all cranes and trolleys. No. 0 grooved wire is standard, and where necessary on long runs is paralleled by a feeder tapped in at regular intervals to equalize the load. Drum type controllers with cast grid resistances are used exclusively; and on all new work, fuses have been replaced by magnetic control which permits instant resetting by the crane operators in case of overload.

Safety Provisions.

In addition to the enclosed wiring and gear guards previously mentioned, all tools are being equipped with no-voltage protection to comply with the ruling of the Industrial Accident Board of California. This will protect workmen from accidental starting of a machine when current is thrown on after an interruption to the power supply.

Continuous Lighting.

As all plants operate day and night, adequate artificial lighting is essential. All general illumination, both inside of the buildings and around the yards and docks, is furnished by type C Mazda lamps of 750, 400 and 200-watt capacity in enameled steel reflectors. These are supplemented, where necessary, by flood-lighting projectors. All cranes carry a cluster of four 750-watt lamps fed from a five-kilovolt-ampere transformer, which steps down the trolley voltage of 440 to 110 at the lamps, and does away with series burning and its disadvantage of the failure of one lamp putting out the other three.

Temporary lighting is by means of hand portables, or 100-watt lamps in cargo reflectors, which, except in the machine shop, are operated at 110 volts. The presence of 220 volts at every tool made the use of this voltage most economical for hand portables in the machine shop. Lamps with left-handed threads are in use for portables, as this has been found the only way to stop the theft of lamps, locks having been of no use whatever.

For carrying material around the yard and between shops, electric trucks of two-tons capacity are employed. Edison batteries are used exclusively, and have held up under almost continuous day and night service. Ampere-hour meters are installed on each truck, and as the driver runs into the station for a boosting charge during the noon hour, two battery inspections per day are possible, and do much to prevent "dead" trucks during winter when the heavy going rapidly drains the battery.

Production of Electricity by Steam Power

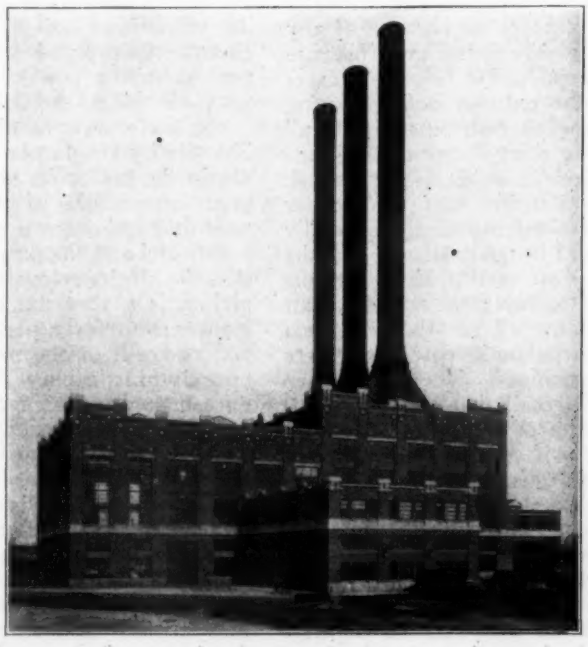
A Frank Statement of the Costs and Possible Further Economies of Electrical Generation in Large Power Plants—Extracted from Address Before American Electrochemical Society

By ALEX DOW

President and General Manager, Detroit Edison Company.

DELIVERED power and generated power are two different factors. Generated power is the actual power produced at the terminals of your machine; the output is the amount of power turned out from your station into the trunk lines. The difference between the two represents uses in the power house for lighting, heating, excitation, the operation of auxiliaries, and all the minor losses incurred in any power-plant output. The net power output is what the great majority of central-station men are concerned with. They have an expression "cost of power delivered," and that relates to the amount of power delivered and presumably paid for. The confusion between these is sometimes, I am sorry to say, intentional. Some persons are inclined to be critical about central-station work, and have the habit of expressing their cost in generated units. In one instance I found a discrepancy between generated units and units delivered to the lines for distribution use of the order of ten per cent. And when that error was made the costs were not worth looking at twice. Costs so remarkable proved to be only good average practice.

The final figure, delivered power, varies again a great deal. In a close network, such as serving one big mill owning its own power plant, the difference between the power generated and the actual delivery to the points of use, may be eight or ten per cent. In a complex network, covering a large area and delivering power in different forms, the order of difference is more likely to be twenty per cent and upwards. That is to say, if the meters of a large central-station network account for eighty per cent of the current generated at the power house, or of the output from the power house, they are doing very well and the distribution efficiency is first-class. There are many well operated networks which from obviously unavoidable conditions do not have a distribution efficiency exceeding 72 or 73 per cent. Commercially the practice is all right, but the difference between power generated and power delivered at the customer's terminals is large enough to be an appreciable factor in the cost.



Connors Creek Station to Which Mr. Dow Refers.

The first division of the steam chamber was made by James Watt; the separation of the steam chamber into successive chambers, all the way from double to sextuple chambers, is something within the memory of most of you; and the establishment, instead of successive chambers, of a long gradient, as in the turbine, is a matter of the last fifteen years. Therein has lain every vital improvement in the steam engine; the others have been, not in design, but in mechanism.

In 1888 I got acquainted with a certain 12 by 12 high-speed engine running 280 or 300 revolutions per minute, in southern Illinois. The problem then put to me was why that engine which could produce a horsepower for every four pounds of coal, why that particular beast should require ten or twelve pounds. That involved a determination of what the engine was doing, and it startled me when I learned that its consumption was 17 pounds of coal. That engine, probably, has many brothers today. You must blame the combination—the boiler, the engine, and then possibly throw in some of the human element. But I had a clear idea then of what load-factor meant, and what a cylinder condenser meant. I became familiar with the automatic cutoffs, and to think that throttling has some virtues. It had and still has.

The Willans law—the law that the steam used by any engine is a constant plus a variable, the variable being proportioned to the load—was the product of just about that period, and was one of the first recognitions made of what actually went on in the high-speed engine.

Willans, you remember, divided his very successful engines into many chambers. He produced the wetted surfaces; he produced a wonderful valve. These are still continued in service today, and they are very hard to beat in steam efficiency, especially if given a little spurt ahead.

I find that vision became a rule, a guiding law, when in 1894 I

found myself called upon to design a plant for a street-lighting load, a matter of 2000 horsepower, four or five units, and during nights a steady light of 4000 hours a year, shut down at daylight, and a trifling load all day. I deliberately selected a steam engine of 160 or 170 pounds pressure, practically a fixed cutoff, although there was a governor of a sort; and I met the occasion of a day load, which ran from 150 down to 75 horsepower by the expedient of letting the steam pressure run from 160 or 170 on the boilers down as low as it would go before I did any firing. The result was it reduced the use of coal to 4 pounds per kilowatt-hour, which would be equivalent to 2½ per indicated horsepower. I and my associates deliberately chose series-wound dynamos of rather low efficiencies, down in the eighties, as against better dynamos of better types; the problem had to be treated as a whole, emphasizing the cost of the load current actually delivered to the street lamps, and as the circuits ran into some fifty square miles of territory to light, it was highly desirable to do as we did and keep transmission losses down to seven or eight per cent, instead of accepting higher power-house efficiencies and let the other run to 18 or 20 per cent, which the higher power-house efficiencies would have predicated. Please notice the acceptance of the lower efficiency at the power house, to obtain maximum delivery at the point of use.

Development of the Steam Turbine.

I could talk for hours on the early history of the steam turbine, of what I have myself seen, touched and smelled. The days of De Laval, and the days of the early Parsons turbine, and the days when 10,000 revolutions per minute was spoken of in hushed tones, and was unbelievable, and the days when we began to understand the stresses in the turbine disk. And the days when we got a hacksaw and got inside the cylinder and then put in a blade and bent it to the required curve; this was well enough to demonstrate the principle, but it did not mean a running machine of commercial value.

These were the days also of the rotary engine. Some local gentlemen may remember the time when a rotary engine was very prominent here, and it finally disgusted a very capable inventor, not because of any inherent fault in the rotary engine, not even because the turbine was going to develop, but because a careless engine-man shut off the exhaust before closing off the throttle and the engine distributed itself all over. I have had the same thing happen. It is interesting when a turbine decides to act as a shrapnel.

Then came the practical turbines of the smaller sizes, a good staunch horizontal machine, essentially the Parsons turbine modified in many details and the characteristic American type of vertical-shaft turbine.

In 1902 I had the nerve to buy three 2000-kilowatt vertical turbines, as alternates. I got them in 1904 and they remained in service until 1910, and were then displaced by better machines. There were two sister machines. You will recall that these vertical-shaft machines ran on a film of high-pressure water or oil. What would happen if one of those turbines, with its thirty, forty or fifty tons of mass, came down on the step bearing through the cutting off of the film of water or oil, was always an interesting speculation. When it did happen it was seen to be nothing serious. I do not recall the single wrecking of one of those machines due essentially to its going down on the step. I do recall one instance of when the engineer in charge deliberately let the beast down on the bearing surface; the two surfaces not being true had given notice of this state of affairs by a rumbling noise; and then there was a lift. This remedy has been applied with a 14,000-kilowatt machine—which was to turn off the water for just an instant, and then let that 720 revolutions per minute come down to the step-bearing for a fraction of a second; then lift it again by admitting the water. If it is not a milled casting, you will not have any step bearing left. So it was learned that in some engines coming down on the step might be good, and this ceased to be a nightmare.

But the virtue of the machine was its essential ruggedness. Not all of them were rugged; those with all the improvements and highly efficient features were not rugged. But as a rule they were all rugged, and the confidence among present power-house operators in the steam turbine may be said to have its foundation in the continuing use and reliability of those vertical-shaft machines.

They are no longer built. The reason is interesting. Principally it is that the higher rotation speeds, which are commercially desirable and economical, and have some definite advantages, running from 1800 to 3600 turns per minute, these are made better with the horizontal. The vertical shaft will whip, while with the horizontal shaft you have the constant pull of gravity which prevents it from doing gyroscopic stunts.

I recall one machine with a well designed slip-joint between the generator and the turbine; that machine did everything but loop the loop. But the stocky design, the fact that the blades stayed on the turbine, and the economy—it came down to 13 or 14 pounds of steam per kilowatt-hour—all made contributions toward developing the machine in the United States as well as in other countries.

Development of Big Boilers.

In 1908, I believe it was, I made my first personal, real contribution to the reduction of steam-power cost. Up to that time I was merely developing the ideas of other men. Then I came to the conclusion that a large boiler would be perfectly safe and feasible, that a very large furnace was desirable for burning bituminous coal, that stokers should have certain characteristics; and I was able to get financial support to build a power house designed for 56,000 kilowatts, in which the boilers were of that type.

In 1912 two of these boilers were tested very liberally by Dr. Jacobus, and the results of those tests are in the textbooks now. They established the very great importance of the correct adjustment of furnace and stoker, as a part of the furnace, to the proposed fuel and the proposed work. They also decided that the efficiency curve, of the boiler and furnace together, is a very flat curve; that a range in this instance from forty per cent of the nominal rating to 200 per cent of the nominal rating of the boiler was entirely practicable. These limits have not been much exceeded. A design for long range is essentially a compromise design. Please do not overlook that.

Latterly, in 1914 and 1915, came the Connors Creek power house, which represented the best I knew, and which is the reason why I speak to you tonight. The figures of the cost of that power house have been given to the public. They have been published at six months' periods, and by years, and as far as I am advised they have not been for long periods and for a complete power house thus far improved upon. I know of three power houses

in operation and some others coming through, which should beat them eight or nine per cent; but their figures have not been given out, and we are from time to time assured that the beating to which we are entitled has not been given to us.

Fuel cost is the one figure on which comparisons can be made, and fuel cost must be expressed in heat units to meet the comparison. These show, year in and year out, an approximation of 20,000 heat units per kilowatt-hour, with periods below and periods above it. They are the best which can be done with the limitation of that power house.

The house is of a design, and selection of machinery, of the years 1913 and 1914. It is not completed. When completed it will be a little better. From the adaptation of the stoker and the furnace to the fuel it has been carried to the limit of our present knowledge.

The reduction of losses by radiation from the boilers proper is so extreme that the boiler room must be heated for the firemen in winter. The turbines are essentially 12-pound-per-kilowatt-hour machines, and are habitually operated at their best points, about 11½ on test conditions; but we do not rate them at that.

The particularly interesting features at the Connors Creek station are the auxiliaries, the arrangements made for getting the most out of the auxiliaries; and therein lies what I might call Chapter 1 of Instruction. Heat balance: You should not throw heat overboard beyond what you can save. That you shall get as much power out of the steam you make as is possible.

Now, if you will turn your memory back you will recall that feed pumps and condensers and auxiliaries of all kinds were habitually driven from the main engine, and therefore they had the efficiency of the main engine. Practice until recently was exactly that way, and thereby rose a compromise of limited spaces and weight, all running at 24 to 25 inches vacuum, as experience showed that to put the feed water into boilers at that state was more efficient than to get better vacuum at the expense of colder feed water. The colder feed water meant you were pumping heat overboard; and that loss overboard is the hopeless proposition today. That is our big loss.

Put me down as saying that where electric heating, electric steel-making, electric reduction of ores, that when these things are used and the origin of the electricity is in fuel, you are absolutely applying that heat wastefully, considered as an application of heat, and the wastefulness is hopeless. The loss overboard in the condensing water is the big thing. All other losses, radiant losses from boilers and engines, are minor in comparison. The large use of electric heat proves that wise men are willing to pay for electricity's other merits.

A hot boiler room is bad engineering—to be hot in the summer time is an offense to the men, and to be hot in winter means that you are warming all outdoors through the windows and the walls and the roof of your place. And then the losses in auxiliaries are very great. You will recall that the next drive after auxiliaries was through the improvements in the pumping devices. We had the theory propounded that inasmuch as these were always operated with a closed cycle, the steam used in those auxiliaries was not a loss, but the heat therein was returned to the system, but it was returned without removing anything like the amount of power which should have been removed.

Features of the Connors Creek Plant.

The Connors Creek plant, which as far as I am aware, was not begun or taken from any other design, but was one of my own sketches made in 1912, has for station operation separate generators, exhausting into condensers whose temperature is controlled according to the requirements of the feed water. That is to say, you run a separate electric generator of comparatively small size, and from that you drive your auxiliaries; and the exhaust from that turbogenerator goes to heat your feed water to an economical temperature. That temperature being settled, you get out of the steam which goes to supply your auxiliaries all the power and likewise all of the heat, and your auxiliaries have the great convenience of the electric drive.

At Connors Creek we have a method which is capable of various and numerous changes. In the last sketch the feed pump is also made electrical, with the steam feed pump to meet occasional conditions. The combinations thereon are legion. I could talk to a mechanically interested audience at least three hours on this subject. Right there let me say that all-steam drive of auxiliaries must be wrong, and all-electric drive usually is wrong. The correct choice lies between the two.

Let me say about Connors Creek, there is no economizer there; that is a commercial proposition. The use of the economizer would unquestionably save 4 per cent of the heat units; and commercially, under the conditions of coal cost as they were two or three years ago, it would not pay. At the present time it would probably pay, if the thing could be "wished into place," and the problems required to be solved in the all-steel economizer could be solved with dispatch. If coal stays at the present ordained figure—not to speak of the actual figures we are paying—the economizer will be warranted.

If put in, the economizer would better the economy 4 per cent, the turbines could be replaced by machines 4 to 5 per cent more efficient, and with the heat balanced by betterments we can see, it would pick up 4 or 5 more per cent. That is to say, we could reduce the present 20,000 heat units per kilowatt-hour to 19,000 or thereabouts. That is an entirely practicable figure at present, without going into new design.

Now the total cost is the fixed cost plus operating cost. It makes a division into standing and running cost, the standing cost being the station rate for service, and the running cost being the added cost due to service. You get there an equation like Willans' Law.

The fixed element is so very large that at poor load-factors it is controlling. Load-factor must come back to you time and time again. With some of you the load-factor is high; with others it is inclined to be low. The electrochemical load-factor is of the order of 90 per cent of what would be obtained if the maximum hours, that is, 8760 hours of use were obtained during the year. You gentlemen are in the habit of telling us you have 100 per cent load-factor. Ninety per cent is going strong, and the eighties are more frequent.

On the other hand, a mixed service is doing well if it shows a load-factor of 40 per cent. Any central station with load-factor above 40 per cent is doing well, indeed. Below that is common. The load-factor of residence lighting is of the order of 8 per cent; that is to say, that lighting costs for residential service are nearly all fixed charges. You can almost forget running charges on residence business. Did we

charge for the same power used for electrochemical service, the difference would be seen to turn on that one point. Residence service uses the equipment about eight-hundredths of the time that electrochemical service might use it.

Now, as to capital cost, the fixed or first element. The capital cost of the Connors Creek first units was between $50 and $60 per kilowatt. If you buy land for 300,000 kilowatts—and you must pro-rate that over the original investment or installation—and you put in railroad tracks, and dike out lakes, and put in all the facilities and offices, all of these cause the unit cost to go high; therefore the variation is between $50 and $60; but the crazy prices of the last two years would make the cost go between $90 and $110 per kilowatt. One hundred and eighty per cent is just about the cost of such construction as compared to the cost we considered normal before the world went crazy. Now, money for that sort of business could be had at rates which do not very much vary.

Taxes on a public-service plant are placed on a liberal basis. We are very honest, we public service people. We always confess to a liberal and honest basis. Now that is no slight matter. Communities which in the past have favored the manufacturer with a low estimate on his plant for taxation purposes will assess a public service corporation up to the eyes; and let me say that taxes in the last year required us to earn $1600 a day, Sundays included.

The cost of money, plus the investment, plus the taxes, means that the central station must figure on a return not less than 12 per cent, and sometimes exceeding 15 per cent. So your first figure, based on the central-station method, is to figure 12 to 15 per cent on the investment per kilowatt. Let me say a word there about depreciation. Depreciation will be affected by use, and a high load-factor will obviously mean a higher rate of depreciation. That should be remembered in any purely electrochemical plant you make.

Now, assume we have the problem put to me by some of your members, that you want a power plant, the object being low total cost of power, and you have some choice of location. The first thing to consider is how the location may affect the power plant; and that leads into those engineering problems I wish to put to you.

With electrochemical industries, of course, you must consider your raw material and your markets. You must have good shipping points; you must have fairly good labor conditions, etc. These conditions would have a large influence in determining the location; and if you leave us free to transmit the power over from a satisfactory location to the power plant, if that be in the premises of this discussion we can forget these considerations for the present and consider one location as reflected in design.

Requirements of a Modern Power Plant.

Take the first item, the fuel cost. If the load-factor is of the order of 90 per cent, fuel cost will be the most important thing to consider. In connection with fuel cost you must consider the certainty of the supply—that it will not be interrupted. One of my sorrows has been the interruption at frequent intervals, and the uncertainty and the impossibility today of getting more than 30 days from a coal shortage, notwithstanding the efforts of the United States Government.

Then you must have plenty of water. The quantity of water used by a big steam plant is something you do not conceive. I know, as every engineer does, the per capita consumption of a mixed residential and commercial community, such as Detroit. I also know the amount of water required to condense the steam for our big turbines. We know waste of energy there is from running too much water through; we know that is uneconomical. A plant of 100,000 kilowatts, operating at 50 per cent load-factor, will require to pass through its condensers approximately the same amount of water as will be used by a mixed residential, industrial and commercial community having a population of 750,000 people. In other words, my power plants take up from the river, heat to 10 or 15 degrees and reject to the river again more water than is pumped for the whole community. Therefore, the water supply is the next thing to consider after a good supply of fuel. You must locate on navigable rivers or streams, or on the Great Lakes.

Cooling towers are devices you must forswear, if you are working for maximum efficiency. One of the most appropriate places for a cooling tower is in the dry Southwest, where the rapid evaporation of an exceedingly dry atmosphere cools the water sufficiently and the night chill gives you a fair start the next morning. To locate a big plant on a country duck pond is foolishness.

In the design of the intakes and the overflows of many of the plants I know, the mistake has been made of making them too small. They have to use booster pumps or poor vacuum has to be put on the condenser. In this particular plant (Connors Creek) the canals leading the water to and from the plant are about the size of railway tracks, and you could almost run a railway train through them.

The next consideration of importance is the labor condition. Power-house labor is changing its character very much. There was a time when the power house got incipient geniuses; that was a mistake. But the day has come for brains, and they are being secured. Today the power-house employees expect good pay and good environment. The employees will jump in and do a dirty job and do it handsomely. They are men who appreciate bathing facilities. The engineer now gets his shower when he goes off watch, and sometimes he calls his relief and takes a shower while his turn is on. You must supply first-class working conditions. These men expect their outside, off-work conditions to be such as they can pleasantly live in when they are off watch, where the older men can bring up their families and the younger members can hope to persuade "the only girl" to come.

Plant Location.

If you locate on a place where people consider the outer appearance you must think of an architect. I can think of three power houses where the outside appearance is a credit to the public spirit of the board of directors, while the inside is a libel upon the architect. Foundations will run to $5 per kilowatt when you locate in a marsh with rock 100 or 150 feet down, and you must pile or go down to that rock; or if you locate on the Ohio River, where you have 70 feet of rise and fall, there you have a serious problem.

These things balance up. The big thing is whether you will locate close to your load or transmit. Now, transmission is expensive. It has a very definite measure as to its capacity and a high figure as to its unit cost. The right of way of your transmission line is another item of high cost. The line loss may be a high cost.

(To be continued.)

Statistics on Undeveloped Water Power in New York State

Report of Conservation Commission Indicates over 2,000,000 Horsepower Available—If These Water Powers Were Fully Developed, Few Steam Auxiliaries Would be Required

INTERESTING statistics on the available water-power resources of the State of New York were prepared recently by the Conservation Commission of that state. These data were submitted to the Committee on Conservation and Natural Resources in the Constitutional Convention of New York and formed the basis of an interesting discussion.

Just at this time, when there is a scarcity of fuel and when the demands for power are increasing daily, it is of interest to observe the enormous undeveloped resources of our country. The results of the survey made of New York State furnishes food for serious thought, particularly when it is seen that there are over 2,000,000 horsepower in undeveloped power available.

The essence of the report is found in the table, reproduced herewith, which gives data under five heads concerning 23 river systems of the state. The Commission, in submitting its report, makes the following explanations and interpretations:

In order that your Committee may properly interpret our figures, the basis upon which they rest must be clearly understood, as you will readily appreciate that the power of a stream may be given anywhere between the power which may be developed at the very lowest stream flow occurring perhaps once in twenty years and the power which may be developed by the same stream at the time of very highest flood flow occurring perhaps once in twenty years also. It is manifest that in between these somewhere lies a point such that any additional power installation over that already installed would not have water to run it a portion of the year sufficient to pay interest, depreciation and other charges upon the investment required. We have found that the power developments in the State of New York have, on the average, been carried

TABLE NO. 1—SUMMARY OF AVAILABLE POWER.

River System. I.	Total Hydraulic Power Available. II.	Total Developed Power. III.	Total Undeveloped Power. IV.	Auxiliary Power Required With Undeveloped Power. V.	Total Ultimate Peak Capacity. VI.
Lake Erie (minor streams)	8,200	4,500	3,700	3,700	16,400
Niagara Falls, Inc., Rapids (Pwr. from diversion allowed by treaty—20,000 c. f. per sec.)	540,000	210,000	330,000	330,000	1,080,000
Lake Ontario (minor streams)	22,000	18,000	4,000	4,000	44,000
Genesee (a)	101,250	29,322	71,928	71,928	202,500
Oswego (b)	91,500	57,000	34,500	34,500	183,000
Salmon (Oswego Co.) (c)	25,000	13,000	12,000	12,000	50,000
Black (d)	183,526	82,682	100,344	100,344	366,052
St. Lawrence (main river)	666,000	48,000	618,000	618,000	1,332,000
Oswegatchie (e)	86,320	23,522	62,798	62,798	172,640
Grass (f)	20,100	3,100	17,000	17,000	40,200
Raquette (g)	166,280	30,425	135,855	135,855	332,560
St. Regis (h)	44,700	4,300	40,400	40,400	89,400
Salmon (Franklin Co.) (i)	12,300	3,700	8,600	8,600	24,600
Chateaugay (j)	18,000	5,500	12,500	12,500	36,000
Lake Champlain (minor streams)	21,000	17,000	4,000	4,000	42,000
Saranac (k)	50,353	17,973	32,980	32,980	101,906
Ausable (l)	41,200	6,400	34,800	34,800	82,400
Upper Hudson (m)	472,980	156,995	315,985	315,985	943,960
Lower Hudson	63,600	32,600	31,000	31,000	127,200
Mohawk (n)	106,700	42,700	64,000	64,000	213,400
Housatonic	1,600	600	1,000	1,000	3,200
Delaware (o)	43,400	3,400	40,000	40,000	86,800
Allegheny	4,800	2,300	2,500	2,500	9,600
Susquehanna	31,300	14,800	16,500	16,500	62,600
Barge Canal	61,800	.....	61,800	61,800	123,600
	2,884,009	$27,819	2,056,190	2,056,190	5,768,018

TABLE REFERENCES.

Storage reservoirs contemplated in above estimates.
(a) 13.4 b. c. f. at Portage.
(b) Storage incidental to building of Barge Canal, only.
(c) 5.2 b. c. f. at Altmar.
(d) 5.2 b. c. f. at Hawkinsville, or equivalent storage at other points.
5.0 b. c. f. on West Branch of Moose River at Higley Mt.
3.4 b. c. f. on Beaver River at Beaver River Flow.
0.7 b. c. f. on Deer River at Copenhagen.
(e) 6.0 b. c. f. above Newton Falls on East Branch.
5.0 b. c. f. above Harrisville on West Branch.
(f) 5.0 b. c. f. at DeGrasse, Clare and Grass River Flow.
(g) 16.0 b. c. f. above Piercefield.
(h) 5.5 b. c. f. above St. Regis Falls and Sylvan Falls.
(i) 2.5 b. c. f. above Chasm Falls.
(j) 4.0 b. c. f. in the Chateaugay Lakes.
(k) 4.0 b. c. f. in the Saranac Lakes.
(l) 3.5 b. c. f. at Cherry Patch Pond, Indian Face and Keene Valley.
(m) 28.8 b. c. f. at Conklingville on Sacandaga River.
11.6 b. c. f. at Indian Lake on Indian River.
5.6 b. c. f. on Upper Sacandaga River.
(n) 8.0 b. c. f. at Hinckley on W. Canada Creek.
2.75 b. c. f. at Delta on the Mohawk River.
(o) 1.6 b. c. f. at Cannonsville and Narrowsburg.

to such a point that they can be operated at full capacity 60 per cent of the year. For the remaining 40 per cent of the year part of the machinery must either lie idle or the power must be supplemented by steam. We have, therefore, taken this as the basis upon which to reckon the power resources of the State. It is manifestly on the safe side, the more modern tendency being to develop to a much greater capacity than this assumes.

In regard to the use of auxiliary power, it should be pointed out that it is very rare indeed that a water power can be operated with the greatest economic results without steam auxiliary when all of the factors entering into the case are studied. In other words, if a water power is good when operated without steam and supplying an unlimited market, it will produce greater returns and be better in almost every respect if supplemented by steam auxiliary. In hydroelectric work the steam auxiliary should be about equal to the hydraulic installation for most economic results in the majority of cases. There are, of course, many exceptions to this statement. This table excludes many powers considered too small or costing too much to be of economic value, and is intended to give only such powers as can, under existing conditions, be made to yield at least customary returns upon the required investment. In all our figures we have intended that this shall surely be an underestimate rather than an exaggeration of the water-power resources of the State.

Our figures assume the construction of certain storage reservoirs as shown by the footnotes. The storage reservoirs assumed are such as have been investigated and found to be economically advisable. The smaller and more expensive reservoirs have not been included. For instance, on the Hudson, we have taken only the Sacandaga and Indian Lake reservoirs, whereas there are probably fifteen or twenty others which have been studied more or less, and indeed one in particular has been very highly recommended for construction. In this feature again we have endeavored to be very conservative.

Explanation of Tables.

Table No. 1, showing the available power in the streams named, speaks for itself, but the following serves to show the method of arriving at the facts given:

Column 1 contains the river system under consideration.

Column 2 shows "Total Hydraulic Power Available." This is the total amount of hydraulic power on the river, both developed and undeveloped, which is susceptible of economic development, the limit of economic development being considered the installation which can be run at full capacity for 60 per cent of the average year, but may have to close down parts of its machinery for the remainder of the year.

Column 3, "Total Developed Power," is derived by summing up the present wheel installation at each of the plants on the river, when the installation is less than that corresponding to the natural flow for 60 per cent of the average year, but when the installation is greater than this "60 per cent installation" the latter amount is used. On the streams where such detailed data are not available, the present installation (from the 1909 power census) has been used.

Column 4, "Undeveloped Power," is the difference between Column 2 and Column 3.

Column 5, "Auxiliary Power Required with Undeveloped Power," is obtained by assuming a steam installation equal to the hydraulic installation. It is assumed that the present plants have available at some point an auxiliary installation equal to their hydraulic installation.

Column 6, "Total Ultimate Peak Capacity," is obtained by doubling Column 2. It is assumed that the total ultimate auxiliary installation will be equal to the total hydraulic installation.

Table No. 2—Power in Which State Claims Interest.

River System.	Amount of Power Available 60% of Average Year. Horsepower.
Niagara River*	330,000
St. Lawrence River*	618,000
Genesee River	36,800
Raquette River	10,000
Saranac River	1,500
Ausable River	1,500
Upper Hudson†	60,600
Barge Canal	61,800
	1,119,600

(Compare with total of Col. IV of Table I.)

*It is believed that the interests of the State in these powers are such as to prevent this development without the consent and co-operation of the State.

†In addition to the stated amount, about 41,900 horsepower will be created by the proposed Sacandaga reservoir between Conklingville and Hadley. That this power should be owned or controlled by the State was considered necessary by the State Water Supply Commission.

Mexican Copper Mine on Dividend Basis.

In view of the present copper situation and its effect on electrical manufacturing and development, including wire for power transmission systems, it is of interest to note that the American Smelting & Refining Company, for the first time in three years or more is enjoying a net income from its Mexican properties. All the mines and smelters in Mexico owned by the company are now operating, except those at or adjacent to Chihuahua, and those at Velardena. Work is carried on under many difficulties, and only to a limited extent as yet.

The Government of Mexico is most anxious to have the company succeed, and laborers are more than willing to work. They are suffering, however, to even a greater extent, comparatively, than the inhabitants of the United States, on account of the high cost of living. It is estimated that the cost of necessities in Mexico is, at the present time, six times greater than during the period preceding the revolution. To meet this situation, the company is importing and selling such necessities to its laborers at cost, or lower, and has largely increased the wages paid.

The greatest difficulty encountered is that of transportation. To overcome this, the company has purchased the necessary cars and locomotives, and is managing, under the permission of the Mexican Government, its own railroad transportation.

The business of the company in Mexico, in connection with the payment of freight and taxes to the Federal Government, and in connection with the employment of its people, has seemed to the Board of Directors to be very important, looking to the welfare of the Mexican Government and its inhabitants. The board, therefore, felt that all difficulties should be overcome without regard to temporary profits. So long, however, as the present high prices of metals continue, the company will be amply repaid.

The income from smelting, refining and mining properties, for the six months' period, together with miscellaneous earnings, amounted to $18,757,899.51, being an increase over similar earnings for the first half of the calendar year of 1916 of $5,528,840.88. From this sum, the usual various general expense items have been deducted.

Editorial Comment

Economies of Steam-Electric Power Production

LOW-COST power is one of the prime requirements of electrochemical industries. Confronted as they are by shortage of hydroelectric power, they have seriously considered the possibilities of purchasing power from steam-driven central stations. With this idea in mind the American Electrochemical Society invited Alex Dow, one of the leaders of the central-station industry, to address it at its Pittsburgh meeting last week. Mr. Dow possesses the rare quality of being a first-class executive and engineer of very wide experience, who does not hesitate to impart to the industry information that may be of the utmost value in meeting the urgent problems of the times. This he did in the address he made at the Pittsburgh meeting. Extended extracts from his remarks, taken from the stenographic report of the meeting, are given on other pages of this issue.

Mr. Dow frankly discusses many of the important features of design and operation of a large steam power house that influence its economy in power production. Many of the facts he brings out, although common knowledge among engineers of such stations, are not as well known by the industry at large as they should be. Mr. Dow has achieved in the Connors Creek station at Detrot, for the designing of which he was so largely responsible, economies of an exceptional order, the reasons for which he has candidly pointed out. He also has explained the precautions that must be observed if features of his design are to be utilized elsewhere to advantage. Engineers will be found to differ with Mr. Dow respecting the use of large boilers, economizers, high-tension transmission on tower lines, and other matters. A careful perusal of his remarks will be found valuable by all who are interested in the subject. We commend to other engineers and executives of large power systems equal frankness in disclosing to the industry and nation methods of meeting power problems of the times with maximum economy, reliability and dispatch.

New Wealth For Old

ACCORDING to an authority connected with the National City Bank of New York, it is time to stop talking about war debts as though all payments upon them were to be sunk into the sea. The expenditures which created the debts were unproductive and the wealth to liquidate the debts must be created in the future, but when it is created it will not be consumed or lost to society by being passed through the Government treasuries and into the hands of the debt holders. That is an error due to the persistence of the idea that wealth is of no value to anybody but those who hold title to it.

Everywhere, of course, there is anxiety as to the effect of the debts upon industry and living conditions after the war, but it is noteworthy that in all countries the people are busy with plans for reorganization and development. It is generally recognized that the main problem is that of getting the people back to work. If the industries can be put on their feet promptly, the fiscal problems can be handled. The early forecasts of war finance went astray because they assumed that the war expenditures would be taken out of capital, but that has been true only in minor degree.

The bulk of the war expenditures consist of labor and of supplies of current production. A year of war means that the work of the year has been to a great extent expended unproductively. It has been lost. But the stock of fixed accumulated capital, in the form of implements, tools, power machinery, electrical equipment, railways, factories, houses, etc., by means of which wealth is produced and trade is carried on, has not been destroyed, except in limited districts. It is for this reason—because the wealth-producing capacities of the countries remained—and because the energies of all peoples were enormously stimulated, that the prophecies of an early end of the war through exhaustion have failed. For a like reason the prophecies of universal poverty, industrial prostration and general bankruptcy after the war are likely to be astray. The world never has very much consumable wealth on hand; its wealth is in the equipment for production. It never does very much buying with money; the purchasing power of every country is in its own powers of production. It is trade based on current production that makes the world's business. As soon as the industries of every country can be put in order and started, as soon as everybody can be put to work and earning something, and trade can be reorganized, markets will be re-established and conditions will naturally become normal.

A Revolution in Credits

THAT this war is bringing into use a revolution in our credit methods is clearly indicated by the attitude of various trade associations, and from some of these the electrical industries can profitably take suggestions. Recently, for example, one of the largest and most widespread of the national organizations adopted a resolution condemning the cash dis-

count as unsound and recommending the trade-acceptance idea. While there was considerable opposition to this from scattered dealers when the committee on credits and collections recommended the change, the resolution went through in the closing hours of the convention with little opposition.

Another development along similar lines is indicated in the report of the committees of another national association, which has been carefully considering problems involving business methods since the beginning of the current year. The outgrowth of this effort is to be a propaganda for specialized education, with a view of obtaining greater efficiency in business. In other words, business economics are to be taught by business men, and the association referred to is co-operating in the creation of a bureau of business economics which will work for the co-ordination of all meritorious activities now being carried on by the various national associations of the country. This will include the standardization of business methods, the elimination of waste, the conservation of resources, and the promotion of community development. Just how far these methods can be applied to electrical manufacturing, jobbing, merchandising and contracting is, of course, open to question, but there is undoubtedly need in the business world of the use of the trade acceptance, information on which can be obtained from any large bank. This would enable the manufacturer or jobber to divide his financing operation, borrowing himself at the bank on commercial paper for a short period to finance the finishing of his products, and using the credit of the purchaser directly at the bank to finance the marketing of the products through dealers and contractors. At the present time the customer's credit in the shape of an open book account is used as a basis for the manufacturer to borrow at the bank.

With the greater use of the trade acceptance the manufacturer simply discounts the obligation of the customer, which is in the form of a trade acceptance, or draft, signed by the customer and accepted by his local banker. These documents can be disposed of by the holders through rediscounting at the bank, or through sale to any banker who is in the market for acceptances. Naturally, the customer's local banker, whose credit is involved, will be more insistent that the acceptance be met promptly at maturity than in the case of payment of an open book account.

The general adoption of the trade acceptance would make for sounder business conditions. It means a greater protection of individual credit, for the purchaser of a bill of goods who is careless about meeting his acceptance maturities would soon find it rather difficult to induce a local banker to accept for him. This would mean a stronger credit situation in this country through the elimination of those who are careless or loose in their business methods.

General use of trade acceptances will also stabilize banking conditions by giving the banks a larger volume of short maturity and rediscountable paper.

New Problems from Price Fixing

FIXING of prices on copper, steel and ore, basic materials used in the electrical and other important industries, has had a markedly beneficial effect in removing the uncertainty which for weeks has halted activity and made precarious any undertaking or contract not placed on a price level that made full allowance for loss due to runaway markets. But it has also brought into the situation new elements of doubt, the unsettling effect of which is likely to last for some time.

These relate to the working out of differentials for widely separated parts of the country made necessary by differing costs of production, to the status of contracts placed at higher prices before the schedule of fixed prices was made public, and last, but perhaps most important of all, to the manner in which general business will fare after precedence has been given to Government needs in all branches of industry concerned in the furnishing of war supplies and in transportation. There is little doubt that there will be enough to go around, but close figuring will be required to solve the problems of supply and distribution that will arise in the next few months.

When they are solved, however, it is reasonable to predict that greater industrial activity than this country ever has known will be the result.

The whole economic situation turns on the duty of this country to furnish material support for the nations that are banded together to fight the battles of democracy. We have had our season of profit as a neutral supplying at high prices the vast quantities of goods needed by belligerents. Now we are in the position of an ally throwing all its resources into the scale to win the war. The load will be heavy, but the cause makes worth while any sacrifice it entails.

In the case of the steel industry, the representatives of the principal producing corporations, under the leadership of Charles M. Schwab and Elbert H. Gary, loyally accepted the scale of prices determined upon, and every effort is to be made to keep production at the maximum. The conferences at Washington have been amicable and there seems to be a general feeling in the industries most vitally affected that the Federal officials and their advisers in the Council of National Defense are disposed to be fair, and all their acts so far have demonstrated a purpose to do nothing that would upset the general business situation.

Largely because the price-fixing officials have been so reasonable, what appears to be a change in the mental attitude of business interests is discernible, in that many are beginning to see the whole problem more in accord with the Government's ideas. This harmony between the tremendous material resources of our country and the Administration at Washington is one of the most potential forces for bringing to an end at the earliest possible moment this savage war of practically all the nations of the earth.

HAPPENINGS IN THE INDUSTRY

Electrical Contractors Favor Broadened Co-operation—Features of New War Revenue Law—American Institute Considers Industrial Research—Electrochemists Discuss War Time Problems

ELECTRICAL CONTRACTORS TAKE IMPORTANT ACTION FOR NATION-WIDE CO-OPERATION OF ELECTRICAL INDUSTRY.

Reorganization and Broadening of the National Association of Electrical Contractors—Most Important National Convention at New Orleans.

What will characterize the seventeenth annual convention of the National Electrical Contractors' Association, which was held in New Orleans October 9 to 13, as the most important in the history of the industry, was a stirring and eloquent address by W. L. Goodwin, of New York, on the "Ills in the Industry and Their Remedies Through the Proposed National Association of Electrical Contractors and Dealers." Mr. Goodwin's address, delivered at the session on Thursday morning, was the result of an exhaustive study covering a period of many years to standardize the distribution of electrical merchandise and obtain greater co-operation between the various branches of the electrical industry.

Mr. Goodwin's address was preliminary to action taken on the new constitution for the Association, which provides for taking into membership practically all of the twenty-five thousand electrical contractors and dealers in this country. The new constitution provides for a complete reorganization of the Association with local, district, state and territorial branches. A new classification of associate members is created, including firms or individuals who deal in electrical appliances.

The opening of the convention on Wednesday was an auspicious one, which will long be remembered by visiting delegates. All of the speakers on the program for the morning session were assembled in an anteroom and, led by President Stearnes, marched to the platform to the music of the "Star-Spangled Banner." Mayor Martin Behrman of New Orleans extended a most cordial welcome to the delegates in true Southern style. W. K. Tuohy, vice-president of the Association, responded in an eloquent address in which he also referred to the important problems which confront the industry.

S. E. Doane, chief engineer of the National Lamp Works, was the first of a number of prominent speakers who addressed the first session, his topic being, "Electrical Manufacturers of America as Compared with Those in Foreign Countries." Mr. Doane stated that our transition from an isolated country to a world power has had its effect on the electrical industry. Electrical manufacturers must give serious consideration to the elimination of waste and prepare for European competition which is inevitable. The tendency in Europe since the war began has been to find cheaper substitutes for practically every commodity, while in this country there is still an undue factor of safety in manufactured product.

W. J. Clark, manager of the Traction Department, General Electric Company, spoke on "Manufacturing Conditions in This Country," pointing out how the electrical industry in every department is far in advance of the European development. He spoke of some of the mistakes which have been made in this country, particularly through insufficient development of water powers, the value of which in relieving the coal shortage under present conditions could not be too strongly emphasized.

S. A. Chase, assistant manager, Supply Department, Westinghouse Electric & Manufacturing Company, spoke on the subject of "The Electrical Dealer from the Manufacturer's Standpoint," in which he stated that the stability of trade conditions has been greatly affected by the lack of co-operation between the different branches of the industry. Distribution, he said, should be through natural and legitimate channels and manufacturers will gladly do their part in the reorganization which is contemplated.

J. N. Shreve, vice-president and treasurer, Electric Cable Company, speaking on "Contractors' Obligations in War Time," pointed out that the electrical contractor needs to consider conservation of his opportunities and profits. Development must be along sound economic lines, all necessary factors being efficient and their place properly recognized by others. The contractor has a definite place. Much wiring work is being done by the "handy man" and others, especially in industrial plants, that could be done better and more economically by the contractor. One reason why the contractor has not come into his own is that he has been a poor salesman, especially lacking in perseverance. The contractor cannot accomplish much without aiding and being aided by a strong association. He needs to develop fuller use of merchandising principles. Instead of shopping around for the cheapest places in buying, the same amount of time and energy used in selling will bring net results of pleasing nature. He should talk motor drive, better lighting, extra outlets, and quality products and in this way rise above competition and secure contracts at his own price. The contractor who goes out and aggressively sells his services will get the cream of the business, leaving the lean to the fellow who sits and waits for the business to come to him.

J. M. Wakeman, general manager of the Society for Electrical Development, concluded the program for the first session by summarizing the efforts of the Society in co-operating with electrical contractors and dealers. He pointed out that as a matter of fact one-half of the money expended in development work by the Society was in the direct interest of this very field.

Reports of the remaining sessions, all of which were largely attended, will be given in our next issue.

IMPORTANT FEATURES OF THE NEW WAR REVENUE LAW.

Authorized by Act of Congress October 3, 1917.

To meet extraordinary expenses of the Government arising from the war, Congress has imposed an extraordinary tax designated to bear directly or indirectly on all people of the United States. Treasury officials now estimate that this new levy will yield about $2,535,000,000. The most important items are: Revenue from war excess-profits tax, $1,000,000,000; from income taxes, $851,000,000; from liquors, etc., $193,000,000; from transportation, $137,500,000; from postage rates, $76,000,000; from motor vehicles, $40,000,000.

War Excess-Profits Tax.

In computing this tax, which applies to corporations, partnerships, and individuals engaged in trade or business, it is necessary to define the use made of the terms invested capital and war excess profits.

Invested capital is defined later by verbatim quotation from the law.

War excess profits is that percentage of net income on invested capital which is found by deducting from the net income of the taxable year, first, a specific sum of $3000 for a corporation, or $6000 for a partnership or individual; second, by deducting the average percentage of net earnings on capital invested in 1911, 1912, and 1913, but this second deduction must not be less than 7 per cent nor more than 9 per cent of the invested capital for the taxable year. If the net income of any establishment for the taxable year is below the average net income of representative similar industries in 1911, 1912 and 1913, the Secretary of the Treasury may allow deduction of a higher percentage.

After determining invested capital and war excess profits according to these rules, the tax rate is computed as follows:

Twenty per cent of war excess profits not in excess of 15 per cent of invested capital; 25 per cent of war excess profits in excess of 15 per cent, but not over 20 per cent of invested capital; 35 per cent of war excess profits in excess of 20 per cent, but not over 25 per cent of invested capital; 45 per cent of war excess profits in excess of 25 per cent, but not over 33 per cent of invested capital; 60 per cent of war excess profits over 33 per cent of invested capital. The tax is effective from January 1, 1917.

Income Taxes.

Incomes in excess of $1000 for single persons and $2000 for married persons are taxed 2 per cent of the excess, in addition to the present tax of 2 per cent on incomes above $3000 and $4000 for single and married persons, respectively. Present law is amended by allowing to heads of families deductions of $200 for each dependent child under 18 years of age, or incapable of self-support.

Surtaxes are added to those now in force, graduated from 1 per cent on incomes between $5000 and $7500, up to 50 per cent on incomes above $1,000,000.

Corporation incomes are taxed 4 per cent in addition to present 2 per cent tax, or a total of 6 per cent. Surplus of corporations, remaining undistributed six months after the end of the taxable year, is taxed 10 per cent, unless actually invested and used in business, or retained for reasonable business requirements, or invested in United States obligations after September 1, 1917. If the Secretary of the Treasury finds such surplus not so used or reasonably required, it becomes taxable at 15 per cent. These taxes are effective from January 1, 1917.

Tax on Munition Manufacturers.

New law reduces the 12½ per cent tax authorized September 8, 1916, to 10 per cent of net income from January 1, 1917, and terminates January 1, 1918, and repeals provision of original law that tax should expire one year after close of war. This tax is in addition to the war excess-profits tax.

Transportation.

Purchasers of transportation are taxed as follows:

Eight per cent on payment for passenger fares exceeding 35 cents each; 10 per cent on payments for parlor car, sleeping car, or stateroom accommodations; 3 per cent on payments for transportation on freight; 5 per cent on payments for transportation of oil by pipe lines; 1 cent for each 20 cents or fraction thereof paid for express charges. These taxes are effective from November 1, 1917.

Steamer tickets costing more than $10, to ports outside of United States, Canada or Mexico, graduated rates from $1 to $5.

Tax on Manufactures.

Automobiles .....3 per cent of gross sale
Cameras .....3 per cent of gross sale
Jewelry .....3 per cent of gross sale
Piano players, phonographs....3 per cent of gross sale
Sporting goods .....3 per cent of gross sale
Yachts and other boats.....
.....50c to $5 per foot over-all lengths

Moving-picture films, unexposed...¼c per lineal foot
Moving-picture films, exposed.....½c per lineal foot

These taxes are effective from date of passage of the law.

Each telephone, telegraph or radio message costing 15 cents or more is taxed 5 cents. This tax is effective from November 1, 1917.

Additional Postage.

Letters (except local or "drop" letters) 1 cent per ounce, making rate 3 cents. Post cards, 1 cent, making rate 2 cents. Parcel post packages, 1 cent for each 25 cents charge or fraction thereof. These taxes are effective from December 1, 1917.

An increase is made in second-class matter rates based on a zone system and differing for advertising and reading portions, effective from June 1, 1918.

Stamp Taxes.

New stamp taxes are levied as follows:

Indemnity bonds, 50 cents each.

Indebtedness bonds, 5 cents per hundred dollars face value.

Capital-stock certificates, 5 cents per $100 face value. Capital-stock transfers, 5 cents per $100 face value. If above par, 2 per cent.

Voting proxies, 10 cents each; powers of attorney, 25 cents each; Customs House entries, graduated rates from 25 cents to $1 each; Customs House withdrawals, 50 cents each; playing cards, 3 to 5 cents additional per pack. These taxes are in effect from December 1, 1917.

Produce sales on exchange, 2 cents per $100. Promissory notes, drafts and checks not payable at sight or on demand, 2 cents per $100 or fraction thereof. Conveyances, 50 cents per $500.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS MEETS AT PHILADELPHIA.

Papers and Discussion on Industrial Research—Two Sessions Held on October 8.

The American Institute of Electrical Engineers held its 333d meeting at the Bellevue-Stratford Hotel, Philadelphia, on October 8. Over 200 members and guests were in attendance. There were two sessions—one in the afternoon and one in the evening—and an informal dinner at 6 p. m. The papers and discussions pertained to industrial research, with special reference to the character and scope of the research work growing out of the requirements of the war.

The afternoon session was called to order by N. Hayward, chairman of the Philadelphia Section, who introduced B. A. Behrend, the senior vice-president in attendance. Mr. Behrend made some preliminary remarks and referred to the absence of President Rice in Japan. L. T. Robinson, chairman of the Committee on Meetings and Papers, then acted as chairman of the meeting.

The first paper, "Industrial Research and the Colleges," was read by the author, Dr. A. E. Kennelly. In this paper, industrial research was defined as scientific investigation directed economically toward improvements in production. Discovery and invention were the sources of new industries, and to this end industrial research, in a broad sense, has been at work since industry began. Modern research proceeds along lines of applied science, whereas in medieval times industry was understood to be skill in handicraft. The growth of industry under changed conditions, due to the advent of the steam engine and mechanical appliances, was traced and its evolutions referred to. Then came a change from skill in handicraft to skill in design of machinery and its operation. The author speaks of the change in the attitude toward scientific training, from one of distrust to one of acceptance, and competition imposes vigilance in the applied sciences. Colleges now recognize the demand for a business and industrial education. Courses in scientific study, which do not require an application of same, and those combining the theoretical and practical were discussed. Outlines were given whereby technical colleges can assist in industrial research. These involved special training of investigators to go into the industries; the taking up of particular industrial problems; by experience in the shops of industrial concerns, and by co-operation between the colleges and the industries.

The second paper, entitled "Industrial Research," was by Dr. F. B. Jewett, which in the absence of the author, was read by E. B. Craft. The general discussion at the afternoon session was participated in by Carl Hering, V. Karapetoff, Alex. M. Gray, E. P. Hyde, L. F. Morehouse, Clayton H. Sharp, W. I. Slichter, Harold Pender, H. A. Hornor, Charles F. Scott and closure by A. E. Kennelly.

The subject of the paper presented at the evening session was "Industrial Research and Its Relation to University and Governmental Research," read by the author, C. E. Skinner. The discussion that followed was by B. A. Behrend, V. Karapetoff, Harold Pender, Oberlin Smith, L. W. Chubb, C. A. Adams, Wm. McClellan, Alex. M. Gray, P. G. Agnew, W. L. R. Emmet and closure by author.

Mr. Skinner's paper comprised an introduction, emphasizing the fact that great activity exists in all branches of research work. He divides research activities into three classes—university, government and industrial. He stated that the principal function of university research should be to train research men, and he gave some suggestions as to the kind of training required. Government research work, which has to do with the development and conservation of natural resources, and with national defense, was taken up and handled in an instructive manner. Under the head of industrial research, a brief description of the Research Division of Westinghouse Electric & Manufacturing Company was given. The desirability of co-operation among all these agencies was set forth.

During intermission between sessions an informal dinner was served, at which there were 200 of the members and their guests present. Remarks were made by N. Hayward and B. A. Behrend; and by W. L. R. Emmet, who touched on some of the activities of the Naval Consulting Board, of which he is a member.

WAR PROBLEMS AND OTHER TIMELY TECHNICAL MATTERS DISCUSSED BY ELECTROCHEMISTS.

Thirty-second General Meeting of the American Electrochemical Society Held at Pittsburgh October 3-6.

One of the best attended meetings of the American Electrochemical Society was that which was held at the William Penn Hotel, Pittsburgh, Pa., last week. Although the technical program was condensed into only three sessions, many important problems were considered. Much time was devoted to inspection trips in and near Pittsburgh.

At the opening session, held on Thursday morning, Dr. John A. Brashear delivered an address of welcome, in which he called attention to the industrial development of the city and to its educational and other important advantages. L. Addicks spoke briefly on the work of the Naval Consulting Board, touching particularly on the numerous solutions for the submarine problem that had been proposed and all of which were carefully considered. J. W. Richards spoke of the readiness of the Navy to appoint graduate electrical engineers as engineer officers on board ship.

The first paper presented was entitled "Shawinigan and Its Electrochemical Industries," by H. E. Randall. A 150-foot fall in the St. Lawrence River at Shawinigan forms a natural water-power site, which has been developed at comparatively low expense. About 300,000 horsepower is now developed at this site and regulation of the river obtained by making it a reservoir about 200 miles long, thus giving it a very steady flow of the highest value to industries requiring cheap power in steady volume. The advantages of this site have attracted many electrochemical plants and a variety of products is now made in the neighborhood. Mr. Randall stated that the Province of Quebec has enormous water-power possibilities not far from Quebec City.

J. L. McK. Yardley presented a paper on "The Substation Problem of the Electrochemical Plant," in which he showed that its solution depends upon the conditions imposed by the power supply that is available and the requirements of the electrochemical industry involved. Soda and aluminum were discussed particularly and the use of rotary converters in connection with same.

Robert Turnbull presented a brief paper entitled

"Electric Pig Iron in War Time," and this showed that electric pig iron has not yet been made direct from the ore on this continent to any extent, although the development of this industry would seem to be attractive. A method used in Canada was described in which low-phosphorus pig iron, which is now selling at a very high price, is obtained by melting steel scrap in an electric furnace. In the discussion on the subject, Mr. Turnbull stated that steel scrap was used in preference to reducing ore on account of the low cost and readiness with which this process could be developed and on account of the quantity of steel scrap that was available. The output was about 700 tons per day and the monthly load-factor 68 per cent. The energy consumption could probably be reduced to about 500 kilowatt-hours per ton.

Other papers presented at this session were as follows: "A Method for the Commercial Analysis of Ferro-Silicon," by Russell E. Lowe; "A Resistance Furnace," by Frank Thornton, Jr., in which a furnace making use of silicon carbide as resistor was briefly described; "The Electric Furnace in the Development of the Norwegian Iron Industry," by Haakon Styri, this paper giving a brief account of the use of electric steel and pig iron furnaces, but showing that the Norwegian Government is favoring non-electric plants; "Resistance Type Furnace for Melting Brass," by T. F. Baily, in which the results were given on the use of a furnace of this type in a brass foundry; "Preparation of Pure Alloys for Magnetic Purposes," by T. D. Yensen; "Influence of Temperature on the Electrical Resistivity and Thermo-Electromotive Potential of Steels," by E. D. Campbell; "Calorized Iron as an Element for Thermocouples," by O. L. Kowalke.

Mr. Yensen's paper showed that the problem of obtaining pure alloys for magnetic purposes is one essentially of conservation. It has been found that a permeability as high as 50,000 can be attained by care in the preparation of special iron alloys. In the same way the hysteresis loss can be reduced from 2000 to as low as 500.

At the session on Thursday evening Alex Dow, president and general manager of the Detroit Edison Company, gave an address on "The Production of Electricity by Steam Power." This important address is given in somewhat condensed form on other pages in this issue. In discussing the subject, L. Addicks stated that in spite of the possibilities of deriving electric power from steam power plants, he felt that water powers were not to be neglected; in fact, it was likely that hydroelectric plants could be developed at more reasonable cost than now would be required for steam plants. For a specific electrochemical plant, however, a steam power plant would be worthy of careful consideration. F. A. Lidbury briefly reviewed the studies made a few months ago of the relative costs of steam-electric and hydroelectric power. He deplored the likelihood of expatriation of electrochemical industries that were needed to supply national necessities, this being due solely to short-sighted restrictions on water-power development. These industries are bound to seek low-cost power even if they have to go to other countries for this purpose. The country does not realize the extent to which water power is necessary for national needs.

The concluding session was held Friday morning. Carl Hering presented a paper on "Suggested Reforms in Some Chemical Terms," which was discussed by W. D. Bancroft, J. W. Richards, F. C. Frary, H. C. P. Weber and Dr. Hering. A paper by C. H. Viol and G. D. Kammer on "The Application of Radium in Warfare" explained some of the uses of radium in therapy and for luminous dials of instruments. A paper by W. D. Marshall on "Chlorine as a War Factor," described the use of liquid chlorine for sterilizing drinking water in the field, and of hypochlorine solution in hospital service.

"Synthetic Gasoline by Electrochemical Means" was the subject of a paper by L. B. Cherry in which was described the passing of mixtures of heavy hydrocarbon vapors and natural gas through electrically heated tubes subjected to high-frequency oscillations, gasoline being thereby formed. A paper by W. M. Corse and G. F. Comstock on "Copper Castings for Electrical Use" described the method of casting copper having 75 to 80 per cent conductivity. Silicon is used as a deoxidizer.

J. L. Jones presented two papers, "The Electrolytic Recovery of Copper and Sulphuric Acid from Copper Mill Pickling Solutions," and "A New Electro Analysis Apparatus." L. C. Turnock in a paper on "Effect of Lithium Hydrate Upon the Capacity of the Edison Storage Battery" showed that the capacity was considerably increased by addition of this agent.

Four papers dealing with corrosion were presented as follows: "The Corrosion of Fence Wire," by O. W Storey; "Electrolytic Pickling Process and Its Effect on the Physical Properties of Metals," by J. Coulson; "The Prevention of Brittleness in Electroplated Steel," by T. S. Fuller; "The Corrosion of Metals by Acids," by O. P. Watts and N. D. Whipple.

Three papers of much theoretical interest were presented by W. D. Bancroft; these were "Theory of Contact Catalysis," "The Poisoning of Catalytic Agents," "Fractional Combustion." Other papers presented were: "Silver Peroxide and the Valence of Silver," by H. C. P. Weber; "Spectroscopic Determination of Small Amounts of Lead in Copper," by C. W. Hill and G. P. Lucky; "Future of Electrolytic Zinc," by Mr. French.

Among the plants visited on Thursday and Friday afternoons and all day Saturday were the following: American Zinc & Chemical Company, Langloth, Pa.; Research Laboratory, American Sheet & Tin Plate Company, Pittsburgh; Atlantic Refining Company, Pittsburgh; Owens Bottle Works, Sharpsburg, Pa.; Laboratory of Youngstown Sheet & Tube Company, Youngstown, O.; Republic Chemical Company's detinning and chlorine plant, Neville Island; Westinghouse Electric & Manufacturing Company, East Pittsburgh; Duquesne Works of Carnegie Steel Company; American Window Glass Company; several educational and research institutions were also visited in Pittsburgh.

New York Jovians Plan for Entertainment of National Convention.

Arrangements are going forward for an unusual and interesting national convention of the Jovian Order to be held at the McAlpin Hotel, New York City, October 22-23. On Monday noon, October 22, the local Jovian League will entertain all visiting Jovians at luncheon. The orator of the day will be Dr. Carl Wallis Petty, who will deliver a patriotic address. Special entertainment features are being arranged for this local luncheon under the leadership of George Williams.

Monday afternoon the business sessions of the convention will be opened by H. L. Doherty, Jupiter of the Order.

NEWS NOTES

Plans National Affiliation of Engineering Societies.—The American Association of Engineers has before it a plan for the national affiliation of local engineering clubs and societies. The secretary of this association recently made a tour of eastern cities to ascertain the views of members of local societies on this proposal, and will make a report to the board of directors of the American Association, the headquarters of which are at 29 South La Salle Street, Chicago. He found general approval and support of the plan.

Meeting of Automotive Electric Association.—The Automotive Electric Association held its summer meeting at Fishers Island, N. Y., on September 6, 7 and 8, at which all member companies were represented. The papers presented were as follows: "Why We Should Standardize Business Forms and Practices," by C. O. Miniger; "Patents," by Victor S. Beam; "Advertising," by J. C. McQuiston. A resolution was adopted to the effect that the members of this association desire to co-operate with the Government to the fullest extent in adopting a uniform standard electrical equipment for its Class A and B military trucks, and will adopt as one of its standards the design which the Government engineers may work out. The next meeting will be held in New York City, January 3 and 4, 1918.

New Officers of Kansas City Jovian League.—The Kansas City Jovian League has elected the following officers: President, A. Penn Denton; vice-presidents, W. M. Hand, J. E. Launder, W. B. Satterlee, F. F. Rossman; secretary and treasurer, T. R. Harber; executive committee, P. Loyd Lewis, M. E. Bates, J. G. Crane, E. E. Stigall. In his address, the retiring president, Mr. Lewis, suggested that the League could perform real service to the community and the industry by assisting in the bringing of electrical concerns to the city, and by promoting the use of electricity there. Mr. Lewis' administration has been particularly notable for the prominence which was brought to the Jovian organization in civic matters, and it enters the new year far more widely and favorably known locally than ever before, and in a position to accomplish much.

New Co-operative Courses at M. I. T.—The latest co-operative enterprise established by the Massachusetts Institute of Technology has been undertaken jointly with the General Electric Company. This is a proposition which on the side of the students gives to them the advantages that an enormous industrial plant with its methods and problems will afford and at the same time the General Electric Company will reap the benefit of the services of a group of selected young men with broad educational foundation. This course affords a distinctive training for technical and executive responsibilities with manufacturing corporations, particularly electrical ones, and covers a period of three years of co-operative engineering and administrative training. While working at Lynn, Mass., the co-operative students will receive compensation as regular employees and on the successful completion of the course will find themselves instantly placed. The course is highly regarded by various industrial leaders and the significance of starting an important educational move like this in war times will be appreciated by all who understand the tremendous need which the war is creating for engineers trained in the executive work of production.

Byllesby Staff as Liberty Bond Salesmen.—The following members of the office staff of H. M. Byllesby & Company formed a "flying squadron" in the service of the Federal Reserve Bank, Seventh District, with headquarters in Chicago, for the sale of second Liberty Loan bonds: Captain Joseph H. Briggs, M. E. Hosely, W. J. Kerr, Wm. H. Dow, A. J. de St. Aubin, I. Newman, James Madden, Wm. E. Kennedy, Melburn Brant; also Wm. G. McKenna, Isaac Milkewitch and M. Sadler, of Cummins, Roemer, Flynn, Milkewitch & McKenna, counsel to H. M. Byllesby & Company. O. G. Corns, of the bond department of H. M. Byllesby & Company, has been selected as a special representative of the Federal Reserve Bank for organization work in the State of Iowa. Eight other members of this flying squadron were recruited from executive offices of other prominent Chicago firms.

Government Orders Six-Ton Electric Furnaces.—The United States Navy Department has placed contracts for seven more six-ton electric furnaces, making a total of 11 purchased recently, with the American Bridge Company. Each furnace calls for the payment of $50,000 approximately, or a total payment of $550,000. Three of these furnaces will be installed at the Government Charleston, W. Va., plant, three at the Watertown arsenal and one at the Washington Navy Yard. The steel produced from these furnaces will be used in the manufacture of ordnance at the Watertown arsenal and at Washington, while the steel produced at Charleston will go into the manufacture of projectiles. The Government will introduce an innovation in the manufacture of ordnance by this method as the solid electrical casting will be bored for the making of short howitzers and even larger guns. It is claimed, however, that the Crucible Steel Company has already adopted this method, and the practice has been used in England for several years, but nearly all of the ordnance made in this country is produced from steel forgings.

Civil Service Examination for Radio Inspector.—The United States Civil Service Commission announces examination for radio inspector, for men only, on November 7. Vacancies in the positions of radio inspector and assistant radio inspector, at entrance salaries ranging from $1,200 to $1,600 a year, in the Bureau of Navigation, Washington, D. C., and throughout the United States, will be filled from this examination. The duties of radio inspectors are primarily to inspect the radio apparatus on steamships, to insure its compliance with the law, and to inspect shore stations. The inspectors may also be called upon to examine radio operators. These duties require some office experience. The duties of assistant radio inspectors will be primarily the assisting of radio inspectors in the enforcement of the wireless communication laws. They are required to inspect the radio equipment on board vessels and in land stations, which involves the carrying of 30 or 40 pounds of testing and measuring instruments. The inspection work requires a knowledge of the installation and operation of the several types of radio installations, including the adjustment and tuning of transmitters and receivers. Further particulars are given in circular No. 2068, obtainable from the Commission at Washington or at its branch offices.

Notes on Commercial Practice

New-Business Methods, Policies, Rates and Kindred Central Station Matters for the Man Engaged in Selling Electricity

Nebraska Power Company's Successful Sale of Cumulative Preferred Stock.

In August, 1917, a block of 7 per cent cumulative preferred stock of the Nebraska Power Company, of Omaha, was made available to its patrons in that city and to the citizens of Council Bluffs, Iowa. It was advertised by an investment company of Omaha, was offered in small denominations at par, and for cash or on a part-payment basis, with the privilege of reservation. Dividends thereon are payable quarterly. It was pointed out by the power company to users of its current that the purchase of such stock offered an opportunity for safe and sane saving, and at considerable profit as well.

The part-payment feature of the offer closed August 31, when more than 500 subscribers to the stock had been accommodated, and more than 50 per cent of the employees of the Nebraska Power Company were included in that number. There were also many reservations of stock, and at the end of September the number of subscribers continued to grow with no appreciable slackening. It is anticipated that the list will have doubled before many months have passed. Through the advertising columns of the Omaha newspapers attention was called to the fact that interest accruing on one share of this stock is sufficient to pay the annual electric current bill of a small consumer, and exact figures were given on a graduated scale along these lines, showing the yearly statement that could be receipted by the interest on two shares, on three shares, and the like. While this statement had an advertising "pull," it was the savings feature that proved the most attractive, in the opinion of the investment concern handling the stock—coupled with the effect of a previous invitation by the company to its patrons to become partners in fact as well as in name, for the betterment of the service.

Before offering this stock on the market in Omaha, the company had adopted the slogan "Your Electric Service Company," and the very letter of this line was and is being observed, under the direction of J. E. Davidson, vice-president and general manager. The whole advertising campaign, therefore, both by the power company and the brokers, was based upon the theory of an active partnership between the producers and the consumers of current. The result of this stock disposition, especially that portion of it conducted on the part-payment plan, during August, is believed to have left the patrons of the company, purchasers or no, in a very amicable spirit. This judgment is based not only on the number of subscribers, but on the hearty response of the employees to Mr. Davidson's request for assistance in creating interest in the proposition, and on expressions reported from various sources among small consumers.

It is a matter of gratification to the Nebraska Power Company that a great majority of the subscriptions were for the smallest denomination of the stock made available, indicating that those of meager means, constituting a still greater majority of the whole number of patrons in its territory, fully appreciated this opportunity for saving, upon which the advertising campaign was really based.

A Realistic Window Display in Office of St. Joseph Central Station.

A late bulletin of the Henry L. Doherty organization contains a description of an interesting window display in the offices of the St. Joseph Railway, Light, Heat & Power Company, St. Joseph, Mo. It consists of a miniature naval display, so realistic as to attract crowds of people. J. H. Van Brunt, vice-president and general manager of the Doherty Company, New York City, who recently visited St. Joseph, where he was formerly stationed, says the size of the ships displayed is the only thing that makes one believe they are not actual men-of-war, for in every detail they resemble the real thing.

With the entire country thinking and talking about war, Mr. Van Brunt believed the crowds which visited St. Joseph recently to attend the fall festival would be more interested in a war exhibit than in anything else. As a result, a machine was designed and constructed which would counterfeit a naval battle. The entire floor space of the main show window was covered with a shallow tank filled with water, blued to resemble the ocean. In the background are miniature mountains and forests, and above a blue sky. At one end of the tank is a fort with guns protruding from it, and searchlights mounted on it to keep a watchful eye on the attacking ships. The feature of the fleet are two dreadnoughts, and these are surrounded with a destroyer, two submarine chasers and two submarines. But the fleet does not merely float about in the tank aimlessly. It fights. By means of an ingenious underwater arrangement, the battleships maneuver, the submarines submerge, and the chasers chase. There is no monotony in watching the apparatus work for it does not appear to repeat what it has done before. For example, sometimes the submarines are completely out of sight, and at other times they travel along with their periscopes showing above the water. Chasing the submarines are the fast little motorboats with miniature anti-aircraft guns mounted on their decks. At night the boats show up by lights shining through their windows, and the searchlight on the fort is continually playing over the water. When the controlling machinery reaches a certain point, the searchlight rests upon a submarine for an instant, whereat the U-boat immediately dives under the waves.

The entire mechanism was built in the shops of the St. Joseph company and is operated by an electric motor in the fort. People came from all over the surrounding territory to see the unusual exhibit. It was such a "crowd getter" that a Kansas City department store is trying to get the exhibit for its windows.

In another window of the St. Joseph company's

offices is an additional exhibit, which also attracted much attention. It shows the growth of the milling industry by contrasting models of old and new plants. One model shows the old-fashioned mill run by a water wheel. That wheel was supposed to generate 50 horsepower. The other model in the window shows the new Larabee mill, which gets its current from the central-station company. The windows of the model are illuminated at night, and as it stands there it is an exact replica of the real Larabee mill with its electric motor of 1500 horsepower. Both the naval and milling displays were installed under the direction of Ralph Foster, window trimmer for the company.

Convenient Table for Finding Cost of Energy Consumption.

To anyone attempting to sell electrical energy or electrical devices, the question is asked almost countless times, "How much will it cost?" The solution, of course, is not difficult, but it is desirable to have the figures handy, so as to show a prospective purchaser in a moment exactly what the cost he seeks actually is.

For this purpose the firm of H. Boker & Company, Inc., 101 Duane Street, New York City, has published the table reproduced herewith. It will be observed that it shows the cost in cents of the energy consumed per hour at various rates. At the left is the column Watts Consumed among which a person can readily find either directly or by interpolation the particular watt consumption desired. Across the top are various rates per kilowatt-hour, ranging by ½ cent from 1 to 10 cents. The figures in the various columns, of course, represent the cost at the watt consumption rate and at the cost rate corresponding.

As an example of the usefulness of this table, suppose it is desired to find the cost per hour of an article taking 200 watts at an energy rate of 5 cents per kilowatt-hour. In the first column the figure 200 is picked out and under the top heading of rate per kilowatt-hour the column 5 cents is chosen. The intersection of the two lines shows 1 cent as the cost per hour in this case.

Instead of interpolation, where the exact energy rate is not given in the first column, it is possible to add together the cost of two or more separate watt figures. For example, find the cost per hour of an article consuming 250 watts, where the energy rate is 5 cents per kilowatt-hour. In this case first one finds the cost per hour for 200 watts' consumption, as given in the above example, and then separately for 50 watts' consumption, the latter being ¼ cent. Upon adding these two figures the result is 1¼ cents per hour.

The table gives the figures for one hour's continuous use. Suppose it is desired to know the cost for a particular number of minutes. In this case multiply the cost per hour by the number of minutes and divide by 60. Of course, in most cases a simple fraction of an hour is the time desired, say ½ or ¼, in which case a direct application of the fraction gives a still more direct result.

Electric Range Sales.

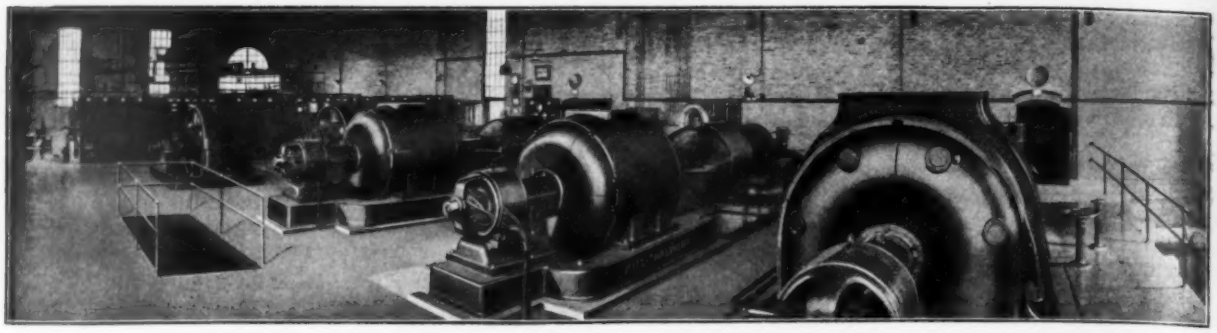
The Albany, Oregon, division of the Oregon Power Company has placed 47 electric ranges during a four months' campaign, and has prospects for a considerable number of additional sales. Contract has been secured with a saw mill adjacent to the company's 11,000-volt line between Corvallis and Philomath, covering its electrical energy requirements amounting to 45 horsepower in motors.

TABLE SHOWING COST PER HOUR OF CURRENT CONSUMED AT RATES FROM 1c TO 10c PER KILOWATT-HOUR

RATE PER KILOWATT-HOUR IN CENTS

Watts Consumed	.01	.01½	.02	.02½	.03	.03½	.04	.04½	.05	.05½	.06	.06½	.07	.07½	.08	.08½	.09	.09½	.10
1	.00001	.000015	.00002	.000025	.00003	.000035	.00004	.000045	.00005	.000055	.00006	.000065	.00007	.000075	.00008	.000085	.00009	.000095	.0001
2	.00002	.00003	.00004	.00005	.00006	.00007	.00008	.00009	.0001	.00011	.00012	.00013	.00014	.00015	.00016	.00017	.00018	.00019	.0002
3	.00003	.000045	.00006	.000075	.00009	.000105	.00012	.000135	.00015	.000165	.00018	.000195	.00021	.000225	.00024	.000255	.00027	.000285	.0003
4	.00004	.00006	.00008	.0001	.00012	.00014	.00016	.00018	.0002	.00022	.00024	.00026	.00028	.0003	.00032	.00034	.00036	.00038	.0004
5	.00005	.000075	.00010	.000125	.00015	.000175	.0002	.000225	.00025	.000275	.0003	.000325	.00035	.000375	.0004	.000425	.00045	.000475	.0005
6	.00006	.00009	.00012	.00015	.00018	.00021	.00024	.00027	.0003	.00033	.00036	.00039	.00042	.00045	.00048	.00051	.00054	.00057	.0006
7	.00007	.000105	.00014	.000175	.00021	.000245	.00028	.000315	.00035	.000385	.00042	.000455	.00049	.000525	.00056	.000595	.00063	.000665	.0007
8	.00008	.00012	.00016	.0002	.00024	.00028	.00032	.00036	.0004	.00044	.00048	.00052	.00056	.0006	.00064	.00068	.00072	.00076	.0008
9	.00009	.000135	.00018	.000225	.00027	.000315	.00036	.000405	.00045	.000495	.00054	.000585	.00063	.000675	.00072	.000765	.00081	.000855	.0009
10	.00010	.00015	.0002	.00025	.0003	.00035	.0004	.00045	.0005	.00055	.0006	.00065	.0007	.00075	.0008	.00085	.0009	.00095	.001
11	.00011	.000165	.00022	.000275	.00033	.000385	.00044	.000495	.00055	.000605	.00066	.000715	.00077	.000825	.00088	.000935	.00099	.001045	.0011
12	.00012	.00018	.00024	.0003	.00036	.00042	.00048	.00054	.0006	.00066	.00072	.00078	.00084	.0009	.00096	.00102	.00108	.00114	.0012
13	.00013	.000195	.00026	.000325	.00039	.000455	.00052	.000585	.00065	.000715	.00078	.000845	.00091	.000975	.00104	.001105	.00117	.001235	.0013
14	.00014	.00021	.00028	.00035	.00042	.00049	.00056	.00063	.0007	.00077	.00084	.00091	.00098	.00105	.00112	.00119	.00126	.00133	.0014
15	.00015	.000225	.0003	.000375	.00045	.000525	.0006	.000675	.00075	.000825	.0009	.000975	.00105	.001125	.0012	.001275	.00135	.001425	.0015
16	.00016	.00024	.00032	.0004	.00048	.00056	.00064	.00072	.0008	.00088	.00096	.00104	.00112	.0012	.00128	.00136	.00144	.00152	.0016
17	.00017	.000255	.00034	.000425	.00051	.000595	.00068	.000765	.00085	.000935	.00102	.001105	.00119	.001275	.00136	.001445	.00153	.001615	.0017
18	.00018	.00027	.00036	.00045	.00054	.00063	.00072	.00081	.0009	.00099	.00108	.00117	.00126	.00135	.00144	.00153	.00162	.00171	.0018
19	.00019	.000285	.00038	.000475	.00057	.000665	.00076	.000855	.00095	.001045	.00114	.001235	.00133	.001425	.00152	.001615	.00171	.001805	.0019
20	.0002	.0003	.0004	.0005	.0006	.0007	.0008	.0009	.001	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0019	.002
30	.0003	.00045	.0006	.00075	.0009	.00105	.0012	.00135	.0015	.00165	.0018	.00195	.0021	.00225	.0024	.00255	.0027	.00285	.003
40	.0004	.0006	.0008	.001	.0012	.0014	.0016	.0018	.002	.0022	.0024	.0026	.0028	.003	.0032	.0034	.0036	.0038	.004
50	.0005	.00075	.001	.00125	.0015	.00175	.002	.00225	.0025	.00275	.003	.00325	.0035	.00375	.004	.00425	.0045	.00475	.005
60	.0006	.0009	.0012	.0015	.0018	.0021	.0024	.0027	.003	.0033	.0036	.0039	.0042	.0045	.0048	.0051	.0054	.0057	.006
70	.0007	.00105	.0014	.00175	.0021	.00245	.0028	.00315	.0035	.00385	.0042	.00455	.0049	.00525	.0056	.00595	.0063	.00665	.007
80	.0008	.0012	.0016	.002	.0024	.0028	.0032	.0036	.004	.0044	.0048	.0052	.0056	.006	.0064	.0068	.0072	.0076	.008
90	.0009	.00135	.0018	.00225	.0027	.00315	.0036	.00405	.0045	.00495	.0054	.00585	.0063	.00675	.0072	.00765	.0081	.00855	.009
100	.0010	.0015	.002	.0025	.003	.0035	.004	.0045	.005	.0055	.006	.0065	.007	.0075	.008	.0085	.009	.0095	.01
200	.0020	.0030	.004	.005	.006	.007	.008	.009	.01	.011	.012	.013	.014	.015	.016	.017	.018	.019	.02
300	.0030	.0045	.006	.0075	.009	.0105	.012	.0135	.015	.0165	.018	.0195	.021	.0225	.024	.0255	.027	.0285	.03
400	.0040	.006	.008	.01	.012	.014	.016	.018	.02	.022	.024	.026	.028	.03	.032	.034	.036	.038	.04
500	.0050	.0075	.01	.0125	.015	.0175	.02	.0225	.025	.0275	.03	.0325	.035	.0375	.04	.0425	.045	.0475	.05
600	.0060	.009	.012	.015	.018	.021	.024	.027	.03	.033	.036	.039	.042	.045	.048	.051	.054	.057	.06
700	.0070	.0105	.014	.0175	.021	.0245	.028	.0315	.035	.0385	.042	.0455	.049	.0525	.056	.0595	.063	.0665	.07
800	.0080	.012	.016	.02	.024	.028	.032	.036	.04	.044	.048	.052	.056	.06	.064	.068	.072	.076	.08
900	.0090	.0135	.018	.0225	.027	.0315	.036	.0405	.045	.0495	.054	.0585	.063	.0675	.072	.0765	.081	.0855	.09
1000	.0100	.015	.02	.025	.03	.035	.04	.045	.05	.055	.06	.065	.07	.075	.08	.085	.09	.095	.10

Table for Instantly Finding Cost of Operating any Electrical Device per Hour.



Notes on Operating Practice

A Department Devoted to Practical Problems of Plant and Operating Practice With Particular Reference to Electrical Generation and Distribution

STEAM PRESSURES WILL BE HIGHER

Consideration of High Pressures and Critical Temperatures in Power Plants.

By W. F. Schaphorst.

We have attained the lowest steam pressure that is likely to be attained in power-plant practice. It is impossible to go below the pressure of a perfect vacuum. In our up-to-date plants the condensers and air pumps are holding the exhaust pressure to an almost perfect vacuum continuously, and complaints are seldom heard from this direction. We have, however, not used the highest steam pressures obtainable. Engineers are now speculating as to when pressures of 1000 pounds per square inch will be as common as is 150 pounds today. It is a fact that pressures as high as 1000 pounds are being advocated because high pressure means higher efficiency.

We must save coal. Higher pressure will save coal all right, but the question is—Will it pay to install the heavier boilers and make extensive changes in the power plant in order to save this certain percentage of coal? That's the question that is eternally bobbing up, but it is worth solving. And it is the writer's belief that pressures will gradually go up and that before we pass away, we will see the 1000-pound mark reached.

There is one interesting thing about steam that many steam and mechanical engineers have never heard or thought about—critical temperature. What does it mean? Look into your steam table and you will find that as the steam pressure increases the volume of a pound of steam decreases. At 300 pounds pressure per square inch the volume is 1.535 cubic feet. At 100 pounds it is 4.342 cubic feet. At 1000 pounds it is only 0.48 cubic feet. Now, the volume of a pound of water is about 0.016 of a cubic foot, or 27.65 cubic inches, when cold or at ordinary temperature, and when heated there is but little change. We can, therefore, say that since water is but slightly compressible the volume of a pound at 1000 pounds pressure per square inch will remain unaltered. At any other pressure, also, the water remains practically constant.

It is evident, therefore, that as the steam pressure increases, the volume per pound of steam continues to be compressed until at a certain pressure it will have the same volume as the water. What will it be then? Steam or water? What will the pressure be? What will the temperature be? I don't think anybody knows definitely as yet, but that is the point that is known to scientists as the "critical temperature."

According to scientists, steam at the critical temperature has no latent heat. That being the case, there are arguments in favor of using steam of tremendously high pressure. Practically, however, we cannot yet see our way clear to use such dangerous pressures. In the course of time, though, a thousand pounds per square inch will probably be considered a good pressure. Trevithick was called a "murderer" by James Watt, when the former proposed 50 or 60 pounds. Locomotives now use 250 pounds, and so do marine engines and big steam turbines. Steam-driven automobiles are already known to use pressures close to 1000 pounds, and it is well known that the steam car is surprisingly efficient.

A PECULIAR METER PROBLEM.

Serious Errors Introduced by Connecting Two-Wire Meter on Grounded Side of Circuit.

By M. S. Montgomery.

Any meter installer or electrician familiar with meter practice will claim that it is a bad policy to install a two-wire wattmeter in such a manner that the current or series coil of the meter is connected in the neutral or grounded conductor. To do so, as will be readily made apparent from the sketch in Fig. 1, is to offer opportunity for current to pass to the circuit controlled by the meter and yet not be registered. With the meter coil in the neutral or grounded conductor the earth is at all times in parallel with the current coil of the meter. Should a ground occur on the load side of the meter, the current passing through the conductor with no coil in it would consist of two components, namely, that which flowed through the earth and the ground in the circuit, and that flowing through the meter coil. The registration of the meter under these conditions would be less than the actual

energy of the circuit, and a loss of income would be incurred by the company supplying the electricity.

It is readily seen from Fig. 1 that in any installation where the meter current coil is connected in the neutral or grounded side of the circuit energy can be used without knowledge, by an accidental ground on the load side of the meter or by criminal intent. Whether current is obtained unintentionally or by theft, it is important not to install the meter in the neutral.

Recently a case occurred that at first presented rather a mysterious appearance, but when investigated closely was found to be quite simple. It was, however, of more than passing interest as indicating the complexity of some electrical problems and at the same time forcibly indicating how a meter incorrectly connected may allow energy to be used without being paid for for months and even years.

A single-phase wattmeter had been in service for about one and one-half years. It had received the periodic tests and bills rendered were paid without complaint. In fact the installation was one of hundreds, accomplishing its purpose without comment or more than the usual attention. The customer, however, mentioned that his bills were less of late than they had ever been before, and suggested that something was wrong. The load on the meter was the usual number of lights met with in small factories in addition to a one-half-horsepower motor. It was elicited by the customer that it was only since this motor had been installed that his bills had decreased instead of increasing as he had expected them to do.

A check made of the meter connections indicated that the current coil was connected in the ground conductor, which was wrong of course. The solution was clearly that another ground existed somewhere on the customer's premises. Careful measurements, however, showed all clear and the insulation resistance measured up above the average. Again the customer came forward and explained that he had watched his meter at different times, and thought the meter sometimes ran more slowly when the one-half-horsepower single-phase motor was running. This immediately suggested that the motor installation was perhaps the cause of the trouble, a theory made stronger since it was claimed the meter had acted queerly only since the motor had been installed.

The motor was started up and run for half an hour, with and without the other lights burning, but the revolutions of the meter apparently registered the correct amount of energy being consumed. More-

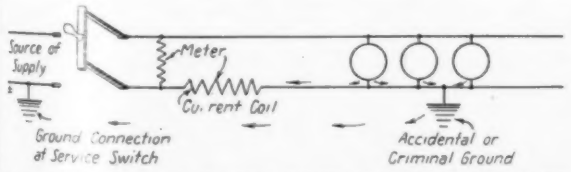


Fig. 1.—How Part of Current Passes Through Meter, When Latter's Current Coil Is Connected in Grounded Side of Circuit and an Additional Ground Occurs.

over, with the motor running the circuits showed clear of ground other than at the service side of the meter. While still puzzling over the behavior of the meter in the past, since everything was obviously all right at the time—except that the meter coil would have to be changed—it was suddenly noticed that notwithstanding the fact that all lights were still burning and the motor still running, the meter had dropped in speed to less than half. An ammeter which had been placed in the same side of the circuit as the meter coil also showed that the current passing through the meter coil had decreased about fifty per cent; tests also indicated that a ground now existed between the meter and the load, on the neutral side.

What actually existed was this: A transitory ground occurred on the neutral from time to time. The single-phase motor operated a small pump which maintained water in a storage tank. The motor was controlled by a float, cutting the motor out when the

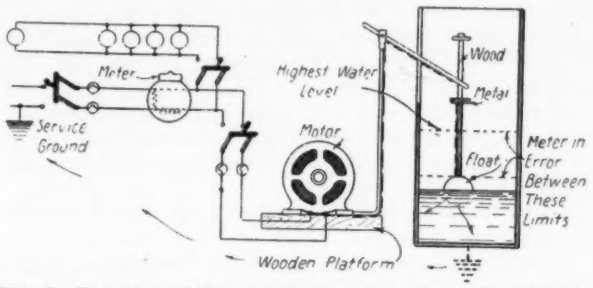


Fig. 2.—Direction of Current Bypass from Motor Terminal to Frame, to Control Mechanism, and (During Higher Water Levels) Down Float Rod to Water, Tank and Ground Back to Service Switch.

water level reached a definite position. The motor frame was insulated from ground by being installed upon a wooden platform, but the motor terminal connected to the neutral (which was connected to the meter coil) was also rigidly in contact with the motor frame. The rod connecting with the float that controlled the motor was also in metallic contact with the motor when the water level was approaching a maximum but was not in contact at any other time because a portion of the guide was made of wood. So long as the float was at a low level the motor was isolated from earth because of its wooden platform and because the upper section of the rod of the float was of wood. When the water level rose, the metallic section of rod came into electrical contact with the motor frame, which was equivalent to making a circuit from motor frame to water, and thence to earth, therewith allowing a portion of the current to flow back to the service without going through the meter coil. The condition can be understood from Fig. 2. This is a typical instance of those mystifying electrical problems that come and go. The remedy was, of course, to interrupt the connection between motor terminal and frame as being the proper thing to do, although in any case the current coil of the meter would have been placed in the other side of the circuit.

As it is now compulsory in many states and cities to ground one side of all low-voltage circuits directly at the service, greater care is needed that central-station income should not be lost due to incorrect connection of the meters.

METHODS OF MORE EFFICIENTLY UTILIZING OUR FUEL RESOURCES.

The Use of Low-Grade Mineral Fuels and the Status of Powdered Coal.

The probability that the coal situation will remain acute for some time to come prompts consideration of every possible means of increasing fuel supplies. Relief has been suggested from the use of low-grade coals, powdered coal, lignite, etc., most of which have hitherto been regarded as wastes. An interesting study of this matter has been made by F. Parkham Coffin,

of the research laboratory of the General Electric Company. A valuable article on his investigations, summarized from the *General Electric Review,* is given in the following:

With the present limited development of our water powers and of our deposits of low-grade fuel, the country is largely dependent upon localized mining activity in the regions where deposits of high-grade coal and oil are found. Large sections of the country receive their fuel supplies by long rail or water routes. They are often subject to delays from shortage of cars, locomotives, or shipping; from congestion of traffic or from transportation or miners' strikes. The cost of freight prohibits the transportation of any but the highest grades of coal for distant consumption. In such parts of the country there are undeveloped deposits of low-grade fuel which can be used locally, by several available methods, in connection with existing equipment.

Low-grade fuel may be burned on grates in furnaces of special construction for each class of fuel, and mechanical stokers are available for burning high-ash coal and lignite. It is probable, however, that low-grade solid mineral fuels of all kinds can be burned to better advantage in pulverized form.

Lump coal, when burned on the grate in a hand-fired furnace, usually requires about 100 per cent excess air. With modern mechanical stokers the usual practice is to use about 50 per cent excess air. With most kinds of pulverized fuel 25 or 30 per cent excess air is sufficient, and with proper attention the amount may be reduced almost to zero. However, the resulting temperature of the fire is a limiting factor, other factors having a bearing on this being the construction of the furnace, the proportion of heat radiated directly on the tubes, and the fusibility of the ash. A properly constructed furnace and burners should be able to burn any form of pulverized fuel which has sufficient volatile content.

For the firing of steam locomotives, pulverized fuel offers a method of mechanical stoking that is beyond competition in all parts of the country where oil is not already in use. It also furnishes a means of utilizing neglected fuel.

Coal can be pulverized more cheaply than it can be gasified and the first cost of a plant for drying and pulverizing is less than for a producer-gas plant. When thoroughly mixed with a blast of air in correct proportion it is practically a gaseous fuel. Powdered-coal firing has most of the advantages of gas or oil firing for steam boilers, when properly applied, and in industrial heating its field of application is constantly growing.

There is little doubt that the most perfect combustion of highly gaseous coals, like lignites, could be brought about by burning the pulverized material in a properly constructed combustion chamber in a draft of air. Such a method, to a limited degree, has been employed with bituminous waste for years in connection with several industries in which large ovens are used, but the machinery and appliances required have hitherto been too large and costly to permit their general adoption in small heating or boiler plants. There seems no good reason why some satisfactory method of using lignite in this manner in small plants can not eventually be evolved. Pulverization of highly gaseous lignites produces fuel with properties closely similar to those of crude petroleum or crude gas; in fact, pulverized highly gaseous coal, like dry lignite, when fed into a furnace with an air blast, gives very largely a gaseous fuel.

With the temperature of the furnace or the combustion chamber once at the proper point, by means of valves the relative supply of coal and air can be regulated so quickly and so perfectly that nearly complete combustion of the heat-producing constituents can be obtained. Besides, with the proper equipment, the feed and the fire should be closely uniform, almost automatic, and requiring comparatively little work from the fireman. When dry pulverized lignite can be used in small boiler settings to advantage; there is no reason why it should not produce a relatively high heating efficiency, for, in a proper combustion chamber, besides the combustion of fixed carbon, this method would utilize nearly all of the volatile gases, which have high calorific power, a proportion of which is lost by the ordinary methods of combustion to which lignite is subjected.

The efficient utilization of our fuel supplies is a subject of constantly increasing importance. Interest in this subject in America has usually been confined to the advocates of the conservation of our natural resources. The fuel supply is still abundant and it has usually been cheaper to burn high-grade coal, or fuel oil, than to bother with peat, lignite, or some of the poorer grades of coal containing a high percentage of ash. In some mining districts a portion of the coal is regarded as refuse for filling, or thrown on the culm piles.

The reserves of bituminous coal and lignite in the United States are immense, but the supply of some of the higher grades, such as coking coal and anthracite, may be exhausted during this century.

The unrestricted use of our better-grade fuels and the ruthless waste and neglect of fuels that should be of real commercial value are phases of our national extravagance that are little short of appalling. The Bureau of Mines has repeatedly called attention to the rate at which the supplies of high-grade fuel are being depleted, and the need of investigations to ascertain how waste in this mining and utilization can be lessened or prevented.

In spite of the immense resources, we are now face to face with a serious coal shortage, owing to limitations of transportation and of labor at the mines. At the same time there is an unprecedented demand for coal to operate the industries of the country and for war purposes.

Parts of the country distant from supplies of high-grade fuel should endeavor to utilize their local resources to a greater extent than heretofore, in order to eliminate the expenses and uncertainties of transportation. Also the development of low-grade fuel deposits should be stimulated and established permanently.

The production of high-grade coal and petroleum is more or less localized, but nearly every section of our continent has local fuel resources within moderate distances of points of consumption. Low-grade fuels are those which have a low calorific value due to the presence of impurities such as ash and moisture. Fine screenings and dust produced in preparing certain high-grade fuels for the market may also be included since it is often difficult to burn them on the grate, when using forced draft, even when mixed with lump coal.

New Stokers Increase Economy and Capacity of Plant.—The Metropolitan Edison Company has nearly completed the installation of eight automatic coal stokers at its West Reading (Pa.) power plant. The installation of these new stokers, which replaces an old type of stoker, will about double the capacity of the boilers and effect important economies in the operation of the plant.

Electrical Construction Notes

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Status and Prospects of the Building Industry.

Statistics compiled by many leading authorities indicate that the war has proven a great stimulus to certain building operations in the United States, government construction has attained enormous proportions, and considerable factory work is going on in large volume. On the other hand, the erection of dwelling houses and other similar structures has fallen off appreciably.

Discussing the present situation and the building outlook, Roger W. Babson, the well known statistical authority says: "Many clients have inquired regarding the effect of the war on building. The following table answers this question more clearly than words. The war will very seriously affect many lines of building, but is stimulating government and certain factory work. Reports from England show a large volume of factory work, both new and remodeling, together with a large amount of government construction. Builders and dealers in builder's supplies who have adapted themselves to the new conditions are fairly busy. Residential construction in England has been almost eliminated since the war began, except for the building of workmen's dwellings in certain industrial centers. Work not necessary to the war has been suspended. In the United States the readjustment doubtless will not be as radical as in England, but the tendency will be the same. Clients should plan accordingly.

	Building Started		
	August, 1917.	July, 1917.	August, 1916.
Residential	$ 22,701,000	$ 22,828,000	$ 35,433,000
Manufacturing	18,823,000	19,593,000	12,083,301
Miscellaneous	63,646,000	78,300,000	57,616,375
Government war construction	48,393,000	38,851,000	.....
Total	$153,563,000	$159,572,000	$105,132,676

	Building Projected		
	August, 1917.	July, 1917.	August, 1916.
Residential	$ 23,838,000	$ 23,283,000	$ 38,341,000
Manufacturing	22,234,000	14,690,000	28,438,000
Miscellaneous	88 853,000	69,490,000	83,883,009
Government war construction	17,241,000	41,614,000	.....
Total	$152,266,000	$149,077,000	$150,662,000

The above figures represent all building in the northern, central and eastern sections of the country, which constitutes about 45 per cent of our total population. The item Government War Construction includes only government work incidental to the war. Regular government building is not included therein.

Complete Electrical Equipment in a Modern Hotel.

About a year ago there was opened the first section of the new Waldorf Hotel at Summit Street and Madison Avenue, Toledo, O. This hotel is a fireproof structure and the management has taken the liberal policy of providing first-class guest rooms and hotel service at moderate prices. The policy has met with such favor that a large addition to the hotel has been made necessary. The work on this is nearing completion and when finished will give this hostelry a total of over 500 rooms, or more than three times the present equipment.

The hotel is very completely equipped electrically. In the new section there is a total of 682 lighting circuits. Each room in the new section has a baseboard receptacle for attachment of portable lamps or similar devices. In the kitchen and laundry there are some 10 motors for driving machinery to facilitate the work in these important departments. The building is wired throughout with a conduit system and a separate conduit system is installed for the Bell and Independent telephone systems. These connect to a large distributing frame and central telephone switchboard. The main feeders for supplying the hotel consist of 2,000,000 circular mil cables. A large roof sign is mounted conspicuously on the corner. All of the electrical energy used in the hotel is furnished by the Toledo Railways & Light Company. Another feature of the hotel in the new section is a large grill room in which a stage will be installed at one end. The entire electrical installation in both the first section and the new section was and is being installed by the Fowler Electrical Supply Company, Toledo, O. The cost of the electrical installation in the new section is about $15,000.

Large Installations of Intercommunicating Telephone Systems.

The Sierra Electric Construction Company, 619 Call Building, San Francisco, Cal., has lately installed in the new Southern Pacific Building in that city an intercommunicating telephone system of over 200 lines capacity, and is now installing in the new Aetna Insurance Building in San Francisco a 100-line capacity intercommunicating telephone system. All this class of work is done inside the building. The Sierra company makes a specialty of installing telephone and signal systems to meet all intercommunication conditions, and all installations are directed by competent electrical engineers. The company is the western representative of the "National Calling System" and also representative of the "Hartung Hospital-Call System," a very up-to-date signalling system for hospitals. H. H. Luveen is general manager of the Sierra Electric Construction Company.

Chicago Electrical Men Meet.—Ernest Palmer, of Chicago, made a very interesting and inspiring address before the Electric Club-Jovian League of Chicago, at its weekly meeting, October 4. Mr. Palmer talked on the duties of the "Four-Minute Men" who are covering the country explaining the aims of the government at moving-picture theaters. Mr. Palmer's talk was followed by the exhibition of a picture entitled, "The Unbeliever Convinced," which graphically illustrated the necessity of the utmost care being used for the prevention of fires. J. E. Latta, of the Underwriters' Laboratories, is the author of the sketch accompanying the picture.

Co-operation in Modern Home and Apartment-House Wiring Practice

Making the Wiring in Residences as Safe as Possible by Following Approved Practice Will Stimulate Greater Use of Electricity in the Household

ONE of the best means for the development of successful co-operation is in the education of all parties concerned to the importance of being familiar with, and complying with, standard rules for the safe construction, installation and operation of electrical appliances. In accordance with this idea, therefore, a section of this paper has been given up to the discussion of a few features which the committee feels are really fundamentally important in carrying out successful co-operation.

In introducing this subject a resume of the causes of fires which occurred during one year in one of the large cities of the Northwest might be of interest at this time. Of a total of 1854 fires only 54 were attributed to electricity in any way. They are listed as follows:

Defective wiring	24
Electric wires	17
Electric iron	10
Broken trolley	3
Total	54

Percent of total number of fires, 2.90.

This is a relatively small per cent in any case, but it should be made less. So far as we are concerned for the purposes of this paper, three of these cases (those due to broken trolley) can be ignored. Of the remaining cases defective wiring leads with almost fifty per cent of the total, and "electrical wiring," whatever that means, is the cause of over thirty per cent. The balance is charged against the electric iron.

It is quite probable that at least a part of the fires attributed to electric irons were really failures in the cords supplying the irons. Furthermore, the causes of fires due to the iron are not usually from defect in the appliance itself, but are almost invariably caused by failure to use a stand for the iron, and to disconnect the circuit when through using it. Continued education of the public should eliminate most of these causes.

Co-operation to Make Electricity the Safest and Most Reliable Servant.

Safety is one of the distinctive advantages attendant on the use of electricity in the home. In spite of its marked freedom from dangers, fires and accidents attributed to it do occasionally occur. Leading electrical interests have long felt that the fine record thus marred retards more rapid development.

This is emphatically brought out in the third part of the report of a committee appointed to promote more general and better wiring of homes and apartment houses, which report was presented at a recent joint meeting of the Northwest Electric Light and Power Association and the Washington Association of Electrical Contractors and Dealers. This third section of the report, reproduced herewith, is a fitting sequel to the two other portions that appeared in our last two issues.

Just at this time when every effort is being made by the Government, as well as by insurance interests, to decrease fire losses and promote conservation in every way, the emphasis on good construction is particularly timely. The electrical industry has nothing to fear from a frank discussion of the subject, in fact, it has much to gain if improved construction and wiping out of hazards results therefrom.

Make Electricity the Safest, Cleanest and Most Reliable Servant.

There is no excuse for fires due to defective wiring, and a large per cent due to the hazy term "electric wires" could undoubtedly be prevented by proper understanding of the limitations of the abuse to which appliances and circuits can be subjected. There is no reason why, with proper care which should result from further education, the use of electrical appliances and electric lighting should not be one of the features emphasized especially by the insurance companies in their general campaigns for the reduction of fires such as they have under way on the Coast.

In regard to the matter of education it should not be amiss here to refer to folders and tags which are being prepared by the National Electric Light Association, emphasizing the proper use and care of electrical devices. Manufacturers have already agreed to attach these tags to their appliances and central stations should, as well as electrical dealers, find it decidedly to their advantage to distribute the small folders which are being prepared.

By proper co-operation of everyone interested and by an educational campaign, it should be altogether possible to eliminate fifty or sixty per cent of the fires now charged to electricity. This is certainly worthy of an effort, not only because of a great saving of property and occasionally life, but also because of the great inducement this would be toward the universal use of electricity.

Co-operation does not consist alone in having everyone—central-station representatives, wiring contractors, and architects—working harmoniously together to convince a would-be customer that he should purchase and use electrical appliances. In fact, this is only one phase of the problem of co-operation.

Real growth in the use of appliances is going to come when the home owner really feels and knows within himself that electricity is the safest, cleanest and most reliable servant he can have. This feeling and knowledge will come to him with real force only when the installations with which he is familiar through his friends, neighbors and possibly through his own past experience are proven to be reliable, safe and generally satisfactory. Such a condition exists only when everyone connected with the electrical industry feels a responsibility resting upon him to use only safe and approved materials and appliances, as well as safe and satisfactory methods of installation. This is one of the most fruitful fields for successful co-operation.

Following the National Electrical Code.

It is unfortunate that not all who are engaged in the electrical industry can see that by this means only can we hope to make satisfactory progress. Never-

theless, there is a universal demand for cheapness and such a demand brings out in this field, as in every other, a class whose desire for gain overpowers their better judgment. Furthermore, there is perhaps a still larger class who desire to do right, but who cannot know from experience just what are the safety limits. The best guide to use is the National Electrical Code prepared by the Electrical Committee of the National Board of Fire Underwriters. This code is universally accepted as standard and all municipalities maintaining electrical inspection departments adopt the Code bodily or else they use it as a base for the majority of their rules, adding such special requirements as seem advisable in their particular locality. Municipalities which have no city municipal inspection department at the present time should consider the establishment of such a department as one of their first and most important steps toward successful co-operation.

Contrary to the belief of many, the National Electrical Code and the municipal electrical inspection department are in no sense a menace to the development of the electrical industry, but if properly applied and conducted are its best friends. They improve wiring conditions, reduce fire hazards, create confidence in property owners and actually compel a large measure of the co-operation which we are advocating in this paper where they are properly applied. The rules are not unreasonable as a usual thing and, although they are not infallible, they generally err on the safe side, and a thorough understanding of the reason for their establishment will usually dispel any feeling of prejudice against them. This knowledge should be possessed by everyone having anything to do with the electrical installations, even including the consumer, and here is where co-operation in the way of education can be of great value. To illustrate this point a few examples of certain rules which most frequently cause friction with the Code and of the reasons for their establishment, or for the establishment of even more rigid requirements, will be given.

Size of Feeder Wires for Residences and Apartments.

The size of service wires into a building is determined by the possible connected load in the building. This in turn is determined by the number of lighting circuits and the full connected load of heating or power appliances permanently connected. The reason for this is based upon the assumption that it might be possible for every circuit to be fully loaded and all on at the same time. Such is not a likely condition, but since by the introduction of various appliances into the home some circuits are considerably overloaded at times, this method of determining the size of service wires is probably about as satisfactory as any that could be established.

Recently, due to the introduction of the electric range into apartment houses, however, a somewhat different situation has arisen. It is obvious that in an apartment house equipped with electric ranges it is extremely unlikely that all the housewives would be preparing the meals at exactly the same time. Even if they were, it is still more unlikely that any of them, much less all of them, would have all of the elements of their ranges on high heat at the same time. This theory has proven out in practice, too, for extensive tests carried out in various parts of the country on apartment-house range loads have shown that at no time does the range load on apartment-house feeders exceed from ten to twenty per cent of the connected load where a large number of apartments are occupied. This value would, of course, increase somewhat with the smaller size apartment houses.

It is obviously unfair, therefore, to require an owner to install four or five times as much feeder copper as he will ever need. Somewhat similar conditions exist also in regard to power feeders, as well as certain classes of lighting feeders. There has been a feeling prevalent for some time that some recognition should be made of demand-factors in determining feeder sizes. The Code has never recognized such factors, however, partially perhaps because of the somewhat meager data available upon which to base these values, and partially because of the difficulty attendant upon the forming of a rule that might be applied universally and only to the proper installation. It is our understanding that the Electrical Committee is seriously considering at the present time some relief in the way of recognizing demand-factors under certain conditions. In the past demands have been allowed in special cases, but there was no assurance that the inspector in another district would allow the same demand to apply in an entirely similar installation. It would indeed be a great relief to have something reasonable and definite that could be applied universally.

After having a number of cases brought before them requesting the granting of demand-factors for the determination of feeder sizes in installations where

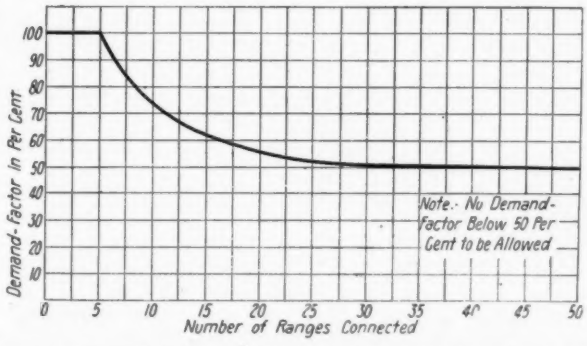


Fig. 1.—Demand-Factor Curve for Determining Size of Electric Range Feeders in Apartment Buildings in Portland, Ore.

it was clearly evident that such requests were just and reasonable, the Board of Electrical Appeals of the City of Portland finally adopted a set of rules and curves setting forth in a definite manner under what conditions demand-factors would be allowed as well as what that demand would be in each case. These rules have been published and engineers may now determine for themselves what their feeder sizes must be in most cases without the necessity of appearing before the board. The curve for electric range feeders for apartment houses, which is the only one applying to the class of buildings under discussion, is shown in Fig. 1.

Importance of Careful Consideration of Carrying Capacity of Wires.

Another much abused rule of the Code is No. 18, which gives the carrying capacity of wires. These carrying capacities are determined not by the total amount of current that the conductor will carry without fusing, but by the amount it will carry without heating sufficiently to seriously affect the life of the insulation.

These values have been determined by careful tests. A very extensive series of careful tests was carried on in 1889 by A. E. Kennelly to determine the

temperature rise caused in wires under different conditions by currents of varing sizes. He found that the effect of the heat on rubber was such that if long life was desired a temperature of 150 degrees Fahrenheit should not be exceeded. This would mean that the permissible rise above room temperature would be a maximum of about 75 degrees, assuming that average room temperature is 75 degrees Fahrenheit. The currents given in Table A of Rule 18 for rubber-insulated wire are 60 per cent of the value of current as determined by these tests, which would produce the maximum permissible heating effect. This factor of safety of 40 per cent is allowed to take care of the inevitable increase in the wattage of lamps or of the number of lamp outlets on a circuit or of the overload of a motor, etc., which occurs on practically every circuit after installation.

The heating effect of a current increases as the square of the value of the current increases, and it is of interest to know that for any given size of wire increasing the allowable current given to three times the value will cause any ordinary insulation to smoke, and it requires no great amount of imagination to realize the value of rubber insulation after such a condition has existed for a short time.

In connection with this rule attention may well be called to the capacity of No. 18 wire, which is three

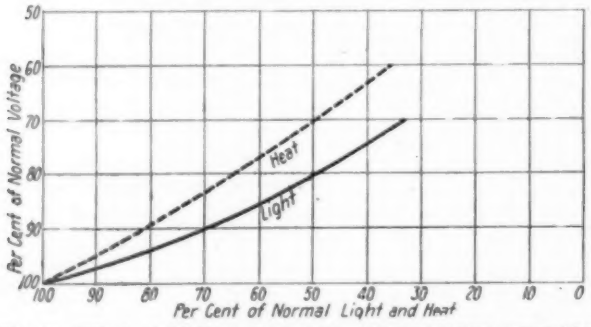


Fig. 2.—Effect of Voltage Drop from Normal Value Upon the Output of Lamps and Heating Devices.

amperes, and of No. 16 wire, which is six amperes. Many fixtures are wired with No. 18 wire and supply three, four or five lamp sockets. Often a percolator, a toaster or a hotplate will be attached to one of the sockets, and the rest of the lamps left lighted. The appliance will take from five to seven amperes and the lamps one or two amperes more. This makes a total load of from six to nine amperes on the fixture wire—two or three times what the wire is rated to carry.

From the preceding paragraph it is plain that such a condition is certain to prove injurious to the insulation in a comparatively short time. The only wonder is that trouble does not develop oftener in fixtures, and this fact in itself explains clearly why it is so important to urge the installation of special wall or floor receptacles for the use of all appliances. Furthermore, these receptacles should be on circuits independent of the lighting outlets, since the lighting circuits are as a rule already well loaded. A little care in explaining the reason for determining the size of feeder copper would therefore explain away many of the objections made against the rule. The owner does not want his installation to deteriorate in a short time.

The voltage drop with its attendant annoyances is another reason for keeping the copper conductor up to a proper size. In fact, on lighting and heating circuits it very often will be the determining factor necessitating the installation of a larger size than that indicated by the current carrying capacity as shown in Table A, Rule 18.

The effect upon lamps and heating devices due to voltage drop is shown by the accompanying curves in Fig. 2. In order to keep the voltage drop within a reasonable value it is advisable that the circuit wire for receptacle outlets shall be not less than No. 12 B. & S. gauge, and not more than six outlets be placed upon one circuit.

Code Rule No. 23 would permit sixteen such outlets upon a circuit. This is not in accord with good practice, however, and the city of Portland (Ore.) definitely limits the number to six. Rule No. 23 permits sixteen lighting outlets upon one circuit. This means socket outlets and not fixture outlets. An unscrupulous contractor sometimes takes advantage of this fact, unless the plans and specifications very definitely stipulate the wattage that must be provided at each outlet. Many plans are not thus protected, and when the full sixteen outlets are placed on one circuit everything is satisfactory until the owner is ready to install his fixtures. He usually decides upon a three or four-light fixture for his living room and about the same thing for his dining room and then discovers that his wiring will permit of only single-light fixtures in either place. The same thing confronts him when later on he desires to install an additional lighting outlet or awakes to the advantages of electric appliances and wishes to install additional receptacle outlets. He must either overload his circuit or install additional circuit capacity, often at a considerable expense.

To protect the owner and to prevent such conditions as far as possible, the city of Portland has adopted the following regulations governing the capacity which must be provided by the contractor:

Minimum circuit capacity to be provided for ceiling outlets (other than beam lights) in dwellings, flats and apartments of five rooms or less—parlors, living rooms, dining rooms, libraries and dens, 120 watts each; floor, flush and wall receptacles, 100 watts each; all other outlets, 40 watts each.

Circuit capacity to be provided for ceiling outlets (other than beam lights) in dwellings, flats and apartments of six rooms or more—parlors, living rooms, dining rooms, libraries and dens, 160 watts; bedrooms, kitchens and reception halls, 80 watts each; floor, flush and wall receptacles, 100 watts each; all other outlets, 40 watts each.

Another Code rule to which considerable attention should be paid is No. 32, which refers to the use of flexible cord. Flexible cord should not be used to support lighting clusters or anything else except a single lamp and shade—the lamp to be not over 200-watt size—since the cord is not strong enough mechanically to support much weight. Neither should lamp cords be tied in knots in any way. For portable work extra heavy cord which has been especially designed for such purposes should be used; since the conductors in flexible cord are brought very close together and the insulation is comparatively thin, it is clearly evident that the chances for short circuit are very great. Moreover, the conductors are composed of many strands of fine wires bound together. The constant bending to which the cords are subjected breaks the small wires and loose, sharp ends are likely to puncture the insulation and cause a short circuit. Such a short, even though the fuse opens the circuit promptly, often causes sufficient arcing to ignite the insulation and set fire to any inflammable material near the cord. Such cords therefore should not be left about covered

with inflammable material or used in show windows or other places of like nature. Proper types of cord used with reasonable care and in the proper places are not in any sense unsafe, however.

Another precaution that should be taken with cords is to see that proper bushings are used where the cord enters sockets, canopies or outlet boxes. Otherwise, the movement of the cord against the sharp edges of the metal will soon cut the insulation.

Proper Fusing of Circuits.

A difficulty that often arises is with reference to the proper fusing of circuits. The purpose of a fuse or circuit-breaker seems to be often misunderstood. It is not merely to fill in a space between the switch and the feeder, as one might readily infer from an inspection of a large number of switchboards that have been in operation for some time. Its function is to act as a safety valve for the feeder. If the carrying capacity of the fuse is greater than that of the feeder, then the fuse cannot functionate properly.

If a fuse of proper capacity will not stay in the circuit, one of two things is true, either there is leakage of some sort on the line or the legitimate load is too large for the feeder. If it is leakage, it should be cleared up at once for it means not only loss of energy, but positive danger. If it is a case of too large a load, then the feeder size should be increased at once, for there is potential danger and eventual loss.

Let no one deceive himself into thinking that he can increase the size of his fuses or "wire" them with impunity. Many a person has encouraged his engineer to wire down the circuit-breaker, install excessive sizes of fuses or even to replace fuses with large size copper wire, and both have smiled at how they have fooled the inspectors. Yet neither one would think of wiring down the safety valve to the boiler. Nevertheless the principle is the same and the different attitude is undoubtedly due to ignorance. Some day the inspector will smile.

The foregoing discussion of certain features of the Code has been introduced because we believe ignorance or the lack of appreciation of the importance of these features is one of the weak links in the chain of co-operation at the present time. Only a few points were discussed, but enough, we feel, to fully illustrate our points.

Education of everyone interested in the use of electricity from the central station to the consumer in regard to the limitations of electrical appliances and materials, as well as in regard to the advantages and proper methods of using them, will eliminate the dangers and overcome prejudice that may remain regarding the value of electrical appliances. When this is done the appliance loads will respond readily to advertising and salesmanship and will rapidly become what we wish them to be.

In conclusion, therefore, let us repeat that successful co-operation consists in a full realization by all interested parties of the fact that safety in the manufacture, installation and use of electrical materials and apparatus is of vital importance. Everyone should become familiar with, and endeavor to live up to, the best rules regarding safe practice in these respects. Municipal inspection departments assist materially in this respect, but there must be a universal feeling of moral responsibility, for it is obviously impossible for an inspector to catch all infractions of the rules. In fact, some of the most serious cases are carefully and designedly concealed from the inspector.

It is the duty of the central station to be the pioneer. It must look into the future and be prepared for what is coming. It must be a leader and not a follower. It must offer to the architect, the contractor and the consumer the latest and most reliable information regarding the various uses of electricity which will be of value to each in his particular line.

It is the duty of the architect and of the contractor to be in a receptive frame of mind and to avail themselves of the assistance offered by the central station in every way in which it can be of value to them and in turn to give the central station the advantage of all the suggestions in the way of better service and better methods which come to them in their own particular fields.

It is the duty of each and every interest, including the consumer, to realize that no business can be conducted on a charity basis, but that each and everyone of the parties interested is entitled to and should receive a reasonable price for his services, which must net him something more than actual cost. Anything over and above a reasonable net return should preferably be given to the consumer in the way of reduced prices and reduced rates.

It should be remembered that in the end the consumer pays the bills, and that he will gladly do this if he can feel and know that he gets full value for his money; that the interest of the architect and of the contractor is necessarily of a temporary nature, except in so far as the success or failure of their work affects their reputation and their opportunities for future work; and finally, that the interest of the central station is a continuing one often throughout the life of the building.

Among the Contractors.

The Electric Construction & Motor Company, Fremont, O., has the contract for wiring the new building of St. John's Evangelical Lutheran Church at Fremont.

The Richter Electrical Company, West Fourth Street, Cincinnati, O., has the contract for the complete electrical installation in the new residence of Mr. Leyman, of the Leyman-Buick Company. This contract amounts to about $4000.

The DeVere Electric Company, Cincinnati, O., is putting in the new lighting for the Hopple Street viaduct, which makes use of combination trolley and ornamental lighting poles. The company has just finished wiring the machine tool plant of the R. K. LeBlond Company. The DeVere company also has the contract for the wiring of a large new factory for the Crown Overall Company, work on which has just begun.

One of the largest and most active electrical contracting firms in Ohio is the Fowler Electrical Supply Company, of Toledo, O. Besides doing general wiring and installation work, this company has for many years made a specialty of the electrical equipment of bridges. Work is now being finished on the bascule bridge at Bridgeport, Conn. At the Navy gun proving grounds at Indian Head work has been begun on the wiring of a lift bridge. The company has just finished extensive electric wiring for a searchlight tower at Fort Hancock. The Fowler company also has the contract for wiring all lighting circuits in the large new Toledo tent works of Hettrick Brothers; about $7000 is involved in this contract. One of the most important contracts on which Mr. Fowler's firm has recently begun work is wiring the huge new power plant for the Toledo Railways & Light Company, in the east side of Toledo.

BOOK REVIEWS

"Underground Transmission and Distribution for Electric Light and Power." By E. B. Meyer. New York: McGraw-Hill Book Company, Incorporated. Cloth, 312 pages (6x9 inches), 156 illustrations. Supplied by Electrical Review Publishing Company, Inc., for $3.00.

The author deserves great credit for attempting the herculean task of writing a book about a subject which has so completely escaped the attempts at standardization that have been applied to most other branches of electrical construction work. That such lack of standardization actually exists can be readily discovered by a glance at Figure 74 on page 166, which shows eight different methods used by eight large cities in pulling cables into the conduits. While a close examination shows that the essential details of the schemes used in two or three cities are practically the same, there are slight differences in the methods or the equipment, so that no two are exactly alike in all respects. The historical sketch in the first chapter gives a number of interesting examples of the earlier types of underground construction used in this country and in England. The chapter does not include, nor does it pretend to include, all of the earlier types of conduit, nor all the types of built-in distribution, as such a complete list would probably have doubled the size of the book. The author has not only had considerable experience in charge of underground work with one of the large eastern companies, but in addition he has been a member of the Committee on Underground Construction and Electrolysis of the National Electric Light Association for a number of years, and has been chairman of the same committee for the last two years. He has, therefore, been in a most advantageous position for learning of the systems of construction and distribution now in use in the principal cities of this country. He has drawn freely from the reports of the committee in securing material for his book, and has added considerable matter drawn from his own experience. The figures of the cost of conduit construction should prove very valuable to engineers who are called upon to handle similar work. The above mentioned difference in standards would indicate that the methods of construction, and perhaps also the costs, are seriously affected by local conditions, and any specifications or figures of costs given in the book should be carefully studied before being used as a basis of estimates so as to see whether or not they are in accord with the local conditions. The same tests should also be applied to similar statements about the relative merits of your types of construction. An example of this occurs on page 15, where statement is made that the cement lined conduit has a very short life. This statement may have been entirely true for the conduits which came under the notice of the author, but in other cities such conduits are still in excellent condition after a service of twenty years. A number of omissions and minor points in arrangement will probably be corrected in future editions of the book. For example, on page 50, back trap valves installed in the rear connections under the floor of the manhole are under the heading "Roof Construction." Some space is also devoted to the subject of waterproof manholes, although no schemes are shown for making the conduits also waterproof, and no mention is made of the fact that waterproof manholes would be of little value unless the conduits connecting thereto were also waterproof. Similar methods of ventilating transformer manholes shown in Figure 118 are under the heading "Underground Transformers," and would hardly be found by anyone referring to the index in looking up the subject of ventilating manholes. It might also be mentioned that the amount of heat carried off by the air by any of the methods shown would probably be but a small fraction of the total transformer losses, and in many cases the amount of cooling secured in this manner would hardly warrant the cost. The examples given on the thickness of insulation of various sizes and voltages of underground cable would lead the reader to think that the practice of the author in using the same thickness of insulation over each conductor and around all the conductors was quite universal, but a number of the larger companies are installing 3-conductor transmission cables in which the outer belt of insulation is less than half the thickness of the inner insulation, and are securing very satisfactory results. A preliminary draft of the Safety Rules for underground construction and operation, submitted by the Bureau of Standards in 1915, is also included. It would have been much better to have included a set of the revised rules instead of a preliminary draft if the former were available. The author is to be congratulated on the general excellence of the work, and it is hoped that other additions will be issued from time to time so as to record the most advanced methods in use in this country.

D. W. ROPER.

"Electric Traction." By A. T. Dover. New York: The Macmillan Company. Cloth, 667 pages (6 x 9 inches), illustrated. Supplied by Electrical Review Publishing Company for $5.50.

As stated by the author, this book is intended for engineers and advanced students. The work is divided into twenty-seven chapters, covering mechanics of train movement, motors and control, auxiliary electrical equipment, rolling stock, track, overhead and third rail construction, feeding and distributing systems, and substations. Generating stations and transmission systems have not been included as the book, already bulky, would have become unwieldy. A collection of sixty-seven problems, and a bibliography are included in an appendix. This book is a typical British work, every topic being considered in minute detail. Although many formulas are included, there is a tendency toward empiricism, which, however, does not mar the book from the standpoint of the practicing engineer. Much material which has been presented in the technical press, as well as a great deal of manufacturers' information, has been included, so that the work is in effect a valuable handbook. Although almost all the examples, and illustrations represent British practice, there is much that will appeal to the American engineer. The text is well written, the illustrations good, and the general standard of manufacture high. The strongest feature is the excellent discussion of electrical equipment for cars and locomotives, which is exceedingly thorough. On the contrary, the treatment of the mechanics of train movement is somewhat shaky in places. None of the modern ways of plotting speed-time and allied curves are included, the time-honored point-by-point method being the only one considered. Although this book is not likely to appeal to a wide class of American readers, it contains so much valuable material that it should prove useful to the practicing engineer who desires to have a broad knowledge of British practice.

A. M. BUCK.

New Electrical Appliances

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

The New Rocker Dump of the Riley Underfeed Stoker.

One of the features which in the past caused much trouble and expense in the operation of underfeed stokers has been the formation of clinker at the lower end of the fire, which finally grew to large masses and welded itself to the bridge wall. Similar formation of clinker on the side wall was also experienced, but did not cause such serious effects in interrupting operations at high capacity; it had more effect on maintenance of brickwork, by tearing off a portion of the brick surface each time a clinker was detached by barring.

The moving retort sides of the Riley stoker practically put an end to the formation of side-wall clinker, by continually shearing off and breaking up any clinker formation while still soft. The same valuable function has now been successfully applied to the bridge wall by means of the new "rocker dump."

The dump plate is attached to a trunnion fastened to the ends of the corresponding side bar. The outer end of the rocker plate is carried by a roller, attached to the racks which formerly supported the older apron dump. The motion at the hinge of course is horizontal, that at the outer end is tangential to the point of contact with the roller, and at all positions of the racks is very nearly vertical. The resultant motion of the dump plate is much as if it were oscillated around an axis situated below the plate. The amount of opening is of course adjustable by means of the racks, the same as with the apron dump.

The design of overfeed section just above the dump plates has been improved with three objects in view:

(a) To reduce the possibility of serious burning at this point by eliminating all large exposed vertical surfaces with small air supply. This is assured by ribbed flat grate bars with a larger number of smaller air openings.

(b) Greater ease of installation and removal of parts, so as to make maintenance of labor as small as possible. This is accomplished by an arrangement which permits the removal of these parts without disturbing other portions of the furnace.

(c) The ability to supply adequate quantities of air to complete the combustion of coke at this point in the furnace. This is secured by the large percentage of air opening, all of which is under the control of the overfeed damper.

The advantages of the new rocker dump as stated by the manufacturer are:

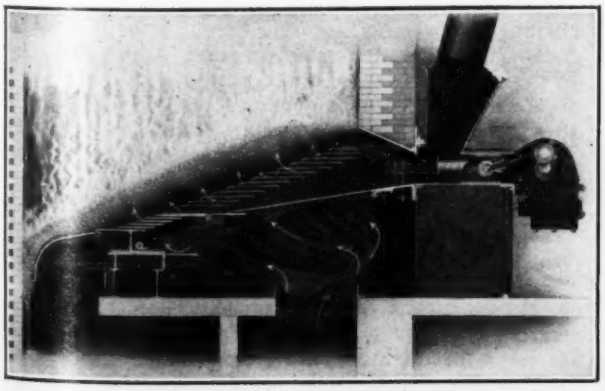
(a) Continual disturbance of ash and clinker on the dump plates, obtaining the same shearing lines as between the retorts, with the resultant breaking up of clinker during formation and giving complete combustion of coke.

(b) Continuous vertical movement at the bridge wall, which practically prevents the adherence of clinker to the bridge wall, crushes what clinker is formed in the fire and ejects it. The maintenance on the bridge wall is consequently much reduced, and high-capacity operation at all times guaranteed.

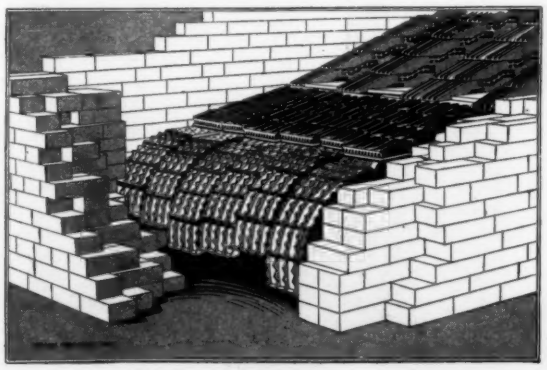
This feature is especially valuable with high percentage of low-fusibility ash. The punishment the bridge wall gets when clinker is allowed to form on it and is then knocked off by heavy blows from a slice bar or power device is very severe. Prevention, of course, is better than cure.

(c) Reduction of dumping period to once in 24 hours or longer, and the practical elimination of smoke during such dumping as is needed. The continuous discharge of ash and clinker keeps the fire in the best condition at all times, instead of permitting the slow reduction of efficiency which begins after a dump and gets worse up to the next dump, in the intermittent-dumping method. The reduction of labor for the fireman is considerable.

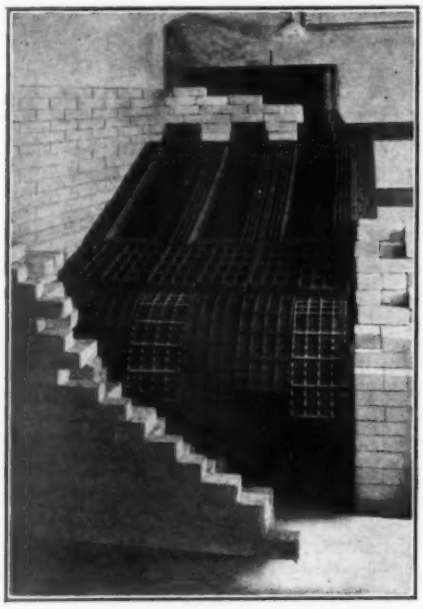
(d) Convenience in handling ashes, since all the refuse comes out in comparatively small pieces, easy to convey and in fine condition for use as fill or for



Cross-Section Through Riley Underfeed Stoker, Showing at Left End the New Rocker Dump for Agitating, Crushing and Discharging the Refuse.



Perspective View of Three-Retort Riley Underfeed Stoker, Showing Relative Movement of the Rocker-Dump Plates.



Looking Into a Three-Retort Riley Underfeed Stoker, Showing Retorts Above and Rocker Dump Below.

cinder concrete. Many plants find this kind of cinder of salable value.

(e) Elimination of deep pockets for collecting ash, which can be, and frequently are, filled with unburned coke after a dump by careless firemen, resulting in burned stoker parts and perhaps even in the disabling of the stoker.

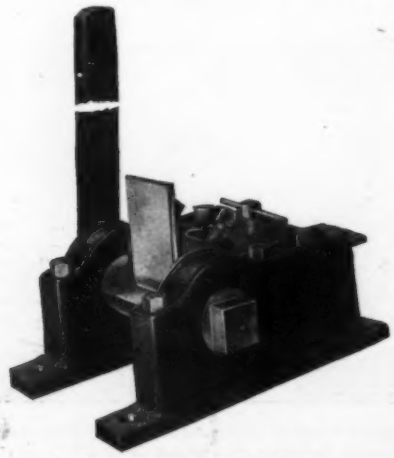
(f) Equipment so designed as to fit directly on the standard stoker, without changes other than the removal of the old-style apron parts and overfeed grates. This renders the new rocker dump immediately available for present installations, as a maintenance proposition. One stoker at a time can be changed over, and all old parts removed used as spares for the remaining stokers, till all are equipped.

(g) This new style dump is operated with the greatest ease for dumping when necessary.

Riley underfeed stokers with the new rocker dump above described are manufactured by the Sanford Riley Stoker Company, Ltd., Worcester, Mass.

Busbar-Bending Machine.

There are many bus-bending devices and machines in use in the hands of the different companies doing electrical construction. Most of these devices have been developed on the job because of the lack of acquaintance with a standard machine for the purpose. One very satisfactory device originating in the field as indicated above, has been standardized by one of the manufacturers and is shown in the accompanying illustration.



Busbar-Bending Machine.

This machine bends equally well all copper bar sections up to and including six inches in width and three-eighths inch in thickness. The bar is run through the bed and clamped firmly in place. The operation of the bending arm causes a generous bending jaw to carry the bar end up to a true right angle or any inside angle more obtuse.

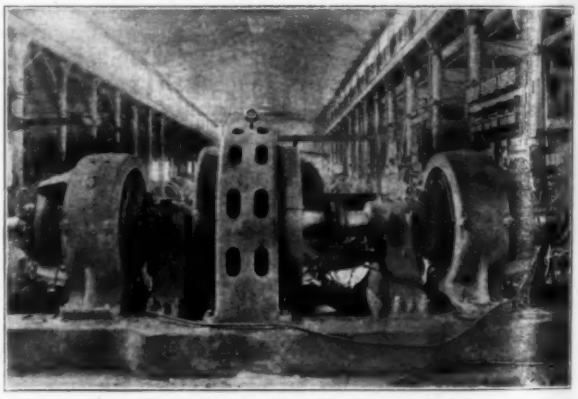
The adjustable top holding clamp may be set, allowing for slight spring back so that with any one section of bar any number of right-angle bends may be reproduced by the complete travel of the operating lever.

The bending jaw does not roll or wipe the moving portion of the bar, but simply follows it through the bend. This feature relieves the possibility of the piece sliding through the machine bed after commencing the bend. By use of the gauge face on the rear end of the machine, any number of pieces may be bent with proper allowance so that they will lie together evenly spaced in a stack after bending.

The machine shown is manufactured by the General Devices & Fittings Company, Chicago, Ill.

Two-Bearing, Three-Unit Motor-Generator Sets.

Two rubber-manufacturing companies in Ohio have each recently installed two three-wire, direct-current motor-generator sets that in construction are a departure from the usual practice. Instead of being of the old four-bearing, three-unit type or the two-unit type with a three-wire generator as one of the units, these sets consist of three units with only two bearings.



Synchronous Motor-Generator Set with Only Two Bearings Undergoing Test at Factory.

These sets, which were designed and built by the Crocker-Wheeler Company, Ampere, N. J., consist of a 845-kilovolt-ampere, 2200-volt, 60-cycle, three-phase synchronous motor driving two 250-kilowatt, 125-volt, compound-wound, interpole direct-current generators.

The use of three units results in greater unbalance overload capacity and greater flexibility of the direct-current voltage than is obtainable with a two-unit set having a three-wire generator as one of the units.

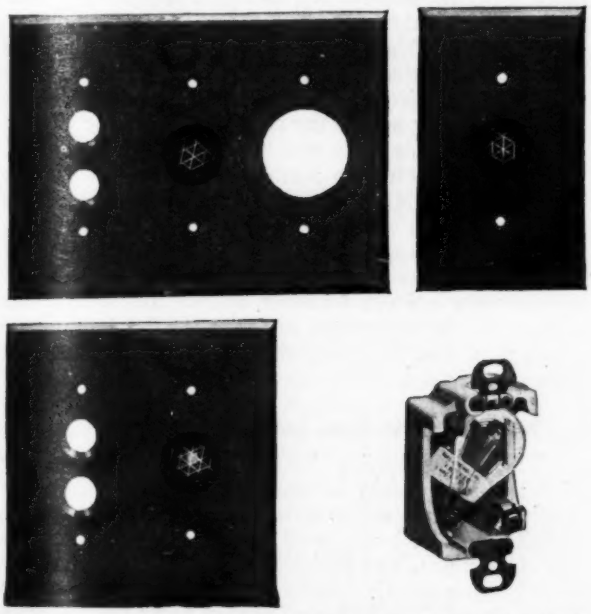
As compared with the old four-bearing, three-unit construction, these two-bearing units are much simpler in construction and have the following advan-

tages: The absence of outboard bearings makes the brushes more accessible for adjustment and the unit can be assembled, dismounted and cleaned more readily. Perfect bearing alinement can also be secured with greater ease as self-alining bearings are used. The machines can therefore be erected with less labor. Because of the shorter length of the set, less floor space is required. Couplings which in some cases constitute a weak link are eliminated.

Pilot-Lamp Outfit for Heating Devices and the Like.

There is a general need for pilot lamps to indicate whether or not heating devices or remote lamps or other appliances are consuming current. For this purpose the General Electric Company, Schenectady, N. Y., has developed a new line of pilot-lamp receptacles and flush plates.

The device consists of a standard size flush plate in which is set a small bull's eye of ruby glass. Behind



Pilot-Lamp Set Consisting of Miniature Lamp, Receptacle and Flush Plate of Several Types.

the bull's eye is a receptacle equipped with a two-candlepower, 125-volt candelabra-base lamp. When current is being consumed on the circuit this lamp lights behind the bull's eye and shines through as a warning signal until the circuit is turned off.

Combination plates can be furnished so that this device can be used in connection with a push-button switch or with a push-button switch and "Standard" separable flush receptacle. These combinations are particularly desirable, as the signal light is located at the point of current control.

New Electric Washer of Tub Type.

Difficulties with laundresses and increasing scarcity of household help is calling for greater use of washing machines. The greatest convenience in this line can be obtained, of course, through the use of electric washers, of which a new type introduced recently is known as the "Easiest Way." This is made in two models; one has the wringer fixed to the tub, whereas the second makes use of a swinging wringer and also uses a new device for reversing the rotation of the wringer. In each case the tub is made of carefully

New "Easiest Way" Electric Washer.

seasoned wood and the motor is mounted below it, so as to be protected and out of the way. The belt drive runs from the motor shaft to a large wheel, from the shaft of which the machine is driven and the wringer operated. There are no exposed gears and the machine is very easily controlled. The wringer can be operated independently of the tub, or both washing and wringing can be done at the same time.

The advantage of the swinging wringer is that it permits wringing clothes from the washing machine to the rinsing water, from the rinsing to the bluing water, and finally from the bluing water to the clothes basket without moving the washing machine itself. A steel folding bench is supplied for the machine without extra cost.

These machines are made by the Easiest Way Manufacturing Company, Sandusky, O.

New Motorless Flasher.

The new Vacu motorless flasher is a unique departure from other types of thermostatic flashing devices, because of the method of disrupting the arc. Unlike remote controls or other types of circuit-breakers, flashers must operate frequently and continually for hours, under the most extreme conditions, because they are used on electric signs which often contain grounds, due to the method of construction, and the fact that many receptacles are exposed to the elements.

A single-circuit type will make and break a circuit

Vacu Motorless Flasher.

about fifteen times per minute. When one stops to consider that this makes a total of 900 operations an hour, it will be appreciated how carefully every detail of construction must be worked out.

The accompanying illustration shows the general details of the new flasher. The circular box contains a glass tube, from which the air has been exhausted, hence the name "Vacu" (short for vacuum). A puddle of mercury floats in the tube, and in each end as well as the center there is a platinum leading-in wire. A rocking arm is operated by resistance wires, these heating and cooling continually while the flasher is in operation. The rocking arm is attached to the metal case containing the tube, which is thus tilted back and forth, either making and breaking a circuit, or alternating two circuits, as the case may be. There being no oxygen in the tube, there is absolutely no deterioration in the contact surfaces, and experience extending over eight years with this feature demonstrates that such a circuit-breaker will last almost indefinitely.

This flasher is mounted in a metal cabinet. It is easily wired. The Vacu flasher is manufactured by the Betts & Betts Corporation, 511-3 West 42nd street, New York City.

Westinghouse Safety Switch for Industrial Plants.

In steel mills, factories, mines, and similar places employing men with practically no knowledge of electricity and its attendant risks, the need for an absolutely safe switch has become a necessity. A really safe switch is one so constructed that all live parts

Westinghouse Safety Switch in "On" or Closed Position.

are totally inclosed and inaccessible. Means should also be provided for preventing operation by unauthorized persons.

The switch shown herewith, which has been brought out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is typical of the best safety-switch construction. Its use assures the maximum protection implied in the word "safety." The complete device consists of an ordinary single-throw knife switch and inclosed fuse holders mounted in an exceptionally strong cast-iron box, with an operating handle outside the housing. The box is designed for conduit connection and has a partition separating the switch blades from the fuse holders.

The upper or switch compartment can be opened only by removing two machine screws. This compartment should never be opened except when making connections, or in case of inspection or repairs, as the switch is opened and closed from the outside by the operating handle, through a shaft and lever inside the box.

The lower or fuse compartment, containing the fuses and fuse holders, is the only part of the switch that need be opened, and then only to replace blown fuses. The door of this compartment is so interlocked with the switch by a vertically acting push rod which engages a boss on the fuse-compartment door, that it can be opened only when the operating handle is in the "off" position and the circuit broken. Furthermore, with the door of this compartment open it is impossible to close the switch. Thus the danger of a live line is eliminated.

The operating handle can also be locked with the switch in the open position, preventing tampering by unauthorized persons.

New Submarine Cable Installed at Portsmouth, New Hampshire.

The Rockingham County Light and Power Company, Portsmouth, N. H., has just completed the installation of a three-conductor No. 2 submarine cable across the Piscataqua River above Portsmouth. The cable is about one mile long and is for operation on a 13,200-volt circuit. This is the second cable laid by the company across the river, a similar installation, except that No. 4 cable was used, being made in 1915.

The new cable was manufactured by the Simplex Wire & Cable Company, Boston, Mass., and was shipped on two reels, by lighter, each reel weighing about 17 tons each. One half of the cable was laid in the forenoon, when the tide was high; the two pieces were spliced together on the lighter in midstream in the afternoon and the second half of the cable was laid the next day when the tide served. The cable laid in 1915 was also of Simplex make.

New Electric-Sign Installation in Chicago.

The accompanying illustration shows an electric sign and illuminated billboard installed at the foot of Michigan Boulevard at Randolph Street, Chicago. The installation which was made by the Federal Sign System (Electric), and which is supplied with energy by the Commonwealth Edison Company, is interesting in many ways. The billboard is said to be the largest in the world and, through the courtesy of the Chicago *Tribune*, is a plea for enlistment in the Navy. The electric sign above replaces the famous Motograph sign which has been commented on so often.

New Electric-Sign Installation in Chicago.

Activities in the Trade

Moloney Electric Company's Chicago office, in charge of Ralph B. Coleman, has been moved from 1716 Fisher Building to larger quarters in suite 1213, same building.

Crocker-Wheeler Company, Ampere, N. J., has taken out a building permit for the construction of a new addition at 485 Fourth Avenue, Newark, N. J., to cost about $20,000.

General Electric Company, Schenectady, N. Y., has had plans prepared for the construction of a new one-story and basement substation, about 48 by 100 feet. The company is also having plans prepared for the erection of a new two-story drop-forge shop, about 85 by 400 feet.

Knapp Electric & Novelty Company, 511 West 51st Street, New York City, has sent forth its new catalog No. 26, illustrating and describing the Knapp line of specialties, including motors of a number of types and capacities; switches, galvanometers and magnets. Prices are given on all equipment.

E. C. Atkins & Company, Inc., Indianapolis, Ind., has issued a small folder entitled "The Straight Road," which has been mailed to members of the Atkins Silver Steel Club, composed of retail hardware salesmen. The folder contains a sales talk, with special reference to the Atkins power saw.

Electric Storage Battery Company, Philadelphia, Pa., has issued sections AB of the 1917 catalog. This deals with Chloride and Tudor accumulators for stationary installations. Complete data are given of the various sizes of cells made in both these types and of various auxiliary apparatus used in connection therewith, such as separators, hydrometers, sediment scoops, lead-burning outfits and various tools.

Harter **Manufacturing Company,** 522 South Clinton Street, Chicago, sends out literature relative to its Nitrolite projector for flood lighting and spot lighting, for use with regular nitrogen-filled type C, 300 to 1000-watt lamps. One of this company's recent bulletins gives good attention to phases of municipal lighting, with the numerous Harter fixtures in use, especially of the large Municipal Pier and the Clarendon Municipal Bathing Beach in Chicago.

Automatic Electric Faucet Company, San Francisco, Cal., has issued a bulletin in which its circulating water heater is illustrated by drawings and half-tone cuts. Several types of such heaters are made. The mechanism is shown in the drawings, as are also shown Kercher's automatic cut-off and thermal switch, attached thereto. In this type of electric water heater there are no coils, and it is of high thermal efficiency, operating on either the 220 or 110-volt alternating current, at capacities of one to 8 kilowatts, according to sizes of electrodes used. In these "Hotwat" appliances, the water is heated by electrodes before it passes into the hot-water tank.

Hughes Electric Bake Ovens are most effectively presented in a 35-page, illustrated pamphlet being distributed to the trade by Hughes Electric Heating Company, 5660 West Taylor Street, Chicago. The book represents the acme of artistic printing and illustrating. A reproduced drawing of the company's factory gives a conception of the magnitude of those works. The sketch of transmission lines extending from a central station to a range of electric bake ovens is expressive of the developed electrical idea; and the cuts of nine or ten types of the Hughes equipment illustrate the stationary and portable styles of two, three and four-compartment ovens, adapted to the numerous uses, from that of the small bakery to requirements of the largest establishment. Their utility for baking bread and pastry, for broiling and roasting, are demonstrated; as are also their readiness, economy and cleanliness. Illustrations of numerous bakeries, clubs and institutions where Hughes bake ovens are used appear in this book. Then the evolution of baking is shown in colors, beginning with ovens of the ancient Egyptians and culminating in the modern electric oven. Such accessories as toasters, coffee urns, and food warmers are shown.

National Lamp Works of General Electric Company, Cleveland, O., is hastening the completion of a large new lamp factory at Minneapolis, Minn. This new plant is a thoroughly modern structure, three stories and basement, and contains nearly 150,000 square feet of floor space. It will turn out some 1,500,000 National Mazda lamps a month. This new plant, with additions to other factories, will increase the output of these lamps considerably and improve lamp deliveries all over the country.

Electrical Machinery Company, Minneapolis, has under construction a new factory, adjoining the one now in use, to be completed and in operation in January, 1918. The result of this improvement will be to so increase shop facilities as to enable the company to triple its present output. The new equipment includes a 25-ton, 4-motor traveling crane, of 60-foot span; several 16-foot boring mills, and numerous lathes, milling machines, punch and drill presses. This company announces the opening of a branch office in New York City, and district offices at Boston, Philadelphia and Buffalo. Orders for vertical generators, synchronous motors and standard alternators have increased beyond the capacity of existing shop facilities. This company specializes on certain types of electrical machines.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a new edition of circular No. 1570. It is entitled "Westinghouse Synchronous Motors for Power-Factor Correction," and was prepared by Nicholas Stahl. This publication explains the characteristics of synchronous motors, discusses the disadvantages of low power-factor and the value of correcting same. The use of synchronous motors as condensers for this purpose is described at length, numerous vector and graphic curves being used. A considerable number of installations of Westinghouse synchronous condensers are described, the most notable of which consists of two motors, each rated at 15,000-kilovolt-amperes, installed in the Eagle Rock substation of the Pacific Light & Power Company, Los Angeles, Cal. The publication is well illustrated throughout.

The Post-Glover Electric Company, 314-316 West Fourth Street, Cincinnati, O., October 3 suffered a very heavy loss by fire, which very seriously damaged its six-story building. The fire broke out in a mysterious manner early in the morning and completely ruined the upper three floors, which, together with roof, fell in. Most of the extensive stock carried by the company was completely ruined or seriously damaged by water. Many valuable switchboard drawings and much special machinery was destroyed, which it will be very difficult to replace. The company was completing a large shipment of electrical supplies for the army cantonment at Chillicothe, O. The loss is estimated as about $400,000 and is quite well covered by insurance. The company has moved into temporary quarters at 332 West Fourth Street and it putting forth every effort to re-establish itself in the electrical jobbing and supply business.

American Insulated Wire & Cable Company, Chicago, Ill., is about to close contracts for the purchase of all ground and buildings immediately adjacent to its plant located at 21st, Sangamon and Morgan Streets. The company also contracted for a 1,000-horsepower electric light and power plant, as well as the buildings and ground on the north side of 21st Street, in the adjoining block. The company is also contracting for the block on the south side of 21st, between Morgan and Fisk Streets. The acquisition of this property added to the present holdings, will give the company a frontage of 746 feet on 21st Street, with an average depth of 238 feet. The above property is being acquired to meet the great demands made upon the company by its constantly increasing list of customers. The company was established in 1899 by Nathan T. Brenner. It is a close corporation and all the stock is owned by the Brenner family. The company manufactures the well known "American" brand weatherproof wire and cables, and is probably the largest manufacturer in its line in the West.

Personal and Biographical

A. S. KALENBORN is now electrical enneer and superintendent of power for the Cerro de Pasco Mining Company, Cerro de Pasco, Lima, Peru. He formerly was electrical engineer for the San Joaquin Light & Power Corporation, California.

R. C. LEEPER has been appointed general manager of the Reno Traction Company, Reno, Nev., to succeed G. W. Hark, who resigned. Mr. Leeper has been with the company since 1907, acting in various capacities and assisting since 1913 in the management of the property.

M. S. SLOAN, vice president and general manager of the New Orleans Railway & Light Company, has resigned to accept a position with the New York Edison Company. No steps have been taken to select a successor, but the matter will be considered at next meeting of the board of directors.

HERBERT B. REYNOLDS now holds the position of mechanical assistant to the superintendent of motive power with the United Railways & Electric Company, Baltimore, Md. He was formerly assistant engineer in the motive power department of the Interborough Rapid Transit Company, New York City.

WALTER S. FINLAY, JR., has become superintendent of motive power for the Interborough Rapid Transit Company, and of the New York Railways, New York City, a position recently made vacant by the death of H. G. Stott. Mr. Finlay formerly was construction engineer for the first-named company.

W. J. DRURY has been appointed manager of the Western Electric Company's distributing house at Cleveland, O., having formerly been sales manager for this company at Dallas, Tex. W. P. Hess, formerly in charge of the Houston branch, succeeds Mr. Drury at Dallas, and G. L. Chestnut succeeds Mr. Hess at Houston.

J. C. ROCKWELL, manager of the railway department of the Manila Electric Railroad & Light Company, Manila, P. I., is visiting the United States with Mrs. Rockwell and their son. While here Mr. Rockwell's headquarters are at the offices of the J. G. White Management Corporation, New York City, which is operating manager of the Manila company.

RUFUS E. LEE recently was appointed general manager of the Nebraska Electric Company, Cedar Rapids, Iowa, having severed his connections with the Lee Light & Power Company of Clarinda, Iowa, a few months ago. The Nebraska Electric Company, although an Iowa corporation, operates in many towns in the northeastern sections of Nebraska, some of which are Bazile Mills, Bloomfield, Creighton, Emerson, Hartington, Niobrara, Wakefield, Wausa and Winnetoon. Mr. Lee is an active association worker in his state and was president of the Iowa Electrical Association in 1914.

E. H. SENNOTT, assistant treasurer of the Metropolitan Building Company, Seattle, Wash., for the last eight years, has resigned to re-enter the employ of the Stone & Webster Engineering Corporation, for which firm he will go to France as a financial director.

CHARLES B. HART is now electrical engineer for the Fort Wayne & Northern Indiana Traction Company, Fort Wayne, Ind., succeeding E. S. Meyers. Mr. Hart has been associated with the company for 15 years and formerly was in the light and power departments.

ALBERT T. REYNOLDS, Albany, N. Y., has been appointed general manager of the United Traction Company, to have charge of the operations of the United Traction Company, the Hudson Valley Railway Company, and the Troy & New England Railway Company, Albany, succeeding Charles F. Hewitt, resigned.

J. M. REID, formerly with the O. L. & I. R. R. Company, which operates a 125-mile electric line between Ogden, Utah, and Idaho points, has been made superintendent of the Mount Hood Railroad, with a 22-mile line penetrating the Hood River valley in Oregon from Portland to Parkdale. Mr. Reid succeeds Ashley Wilson.

E. W. LINDQUIST has been appointed Pacific Coast manager for the Allis-Chalmers Manufacturing Company of Milwaukee, Wis., succeeding Fred. L. Webster, who recently became manager of Chicago territory. Mr. Lindquist formerly was sales engineer with the mining machinery department of the company at Chicago.

GENERAL GEORGE W. GOETHALS recently was elected president of the Wright-Martin Aircraft Corporation, New York, whose airplane contracts with the Government amount to $28,000,000. Plans provide for the construction of a number of plants, the principal one of which is to be at New Brunswick, N. J.

PROF. W. S. FRANKLIN, for many years professor of physics and electrical engineering at Lehigh University, has accepted a position as special teacher and lecturer at Massachusetts Institute of Technology, partly in the Department of Physics and partly in the Department of Electrical Engineering. Professor Franklin is author of many textbooks on electrical engineering and physics used in technical colleges throughout the country.

W. B. S. WINANS, head of the auditing department of Henry L. Doherty & Company, has announced transfers in the auditing staffs of various properties as follows: E. R. Waite, who was in the bookkeeping department of the Denver Gas & Electric Light Company, is to be secretary of the Pueblo (Colo.) Gas & Fuel Company; O. M. Hartshorn, formerly secretary at Pueblo, becomes secretary of the City Light & Water Company, Amarillo, Tex.; L. A. Ramsey, the former secretary at Amarillo, goes in a similar capacity to the Bartlesville (Okla.) Interurban Railway Company; Edwin Wagner, who was secretary to the Bartlesville company, is to be assistant secretary and treasurer to J. E. Ritchie at the Buffalo office of the Dominion Gas Company.

BURWELL S. CUTLER, Buffalo, N. Y., has been appointed chief of the Bureau of Foreign and Domestic Commerce, of Department of Commerce. Mr. Cutler, who is well known in manufacturing circles in Western New York, came into the Bureau six months ago at a nominal salary to assist in putting the organization on a business basis. He was made first assistant chief, but since the resignation of Dr. E. E. Pratt has been acting chief. He was born in Buffalo and finished his scholastic education at Lake Forest University and at Harvard. For fifteen years he has been president of a Buffalo manufacturing concern and has been identified with numerous business houses and civic organizations throughout New York State.

Obituary.

WILLIAM H. SPELMAN, connected with the Interborough Railroad Company, died at his home, 306 Cortelyou Road, Flatbush, near Brooklyn, N. Y., aged 37 years, on September 27.

HARRY W. WEIDMAN, assistant superintendent for the Schuylkill Gas & Electric Company, Shenandoah, Pa., was accidentally killed by an electric shock on September 28. Mr. Weidman was 42 years of age.

J. K. ROBINSON, Chilean representative of the Westinghouse Electric Export Company, died at his summer home, Naples, Me., September 7, after an interesting career in South American trade. Mr. Robinson was born in Chicago in 1866, and secured his technical education at the Massachusetts Institute of Technology. He then entered the employ of the Thompson-Houston Electric Company, which sent him to Chile on construction work. Shortly after, he decided to go into business for himself, and proposed to Lemuel Bannister, then vice-president and general manager of the Westinghouse Electric & Manufacturing Company, that he be made representative of that company at an exposition in Chile. Although Mr. Robinson's only capital was his ability, health and business reputation, Mr. Bannister entrusted him with a large consignment of goods for exhibition and sale. This was the beginning of a life-time connection, during which Mr. Robinson became an engineer of wide repute and one of the best-known Americans on the West Coast. He was a fellow of the American Institute of Electrical Engineers, a member of the New York Electrical Society, and numerous other professional and social organizations in this country and abroad. He is survived by his widow and one daughter and by his mother.

Men in Government Service

Items of Interest Concerning Power and Electrical Men Who Have Joined the Colors

W. G. KNICKERBOCKER, electrician, formerly at Detroit, is now in military service, with the engineering section of the army at Clio, Mich.

M. H. PANCOAST, Lansing, Mich., has joined the U. S. naval coast service as a wireless operator, having recently been at Harvard in training for sea duty.

A. E. MORPHY, Los Angeles, Cal., secretary for Southern California Edison Company, is now in the officers' training camp at the San Francisco Presidio.

JOHN F. TRUMBULL, chief engineer of the Public Utilities Commission of Connecticut, has been commissioned captain in the Engineering Corps, United States National Army.

A. B. STARR, JR., formerly in electrical engineering work, with office at Sewickley, Pa., is now in the National Army, as first lieutenant, Officers' Reserve Corps, Camp Meade, Maryland.

ROBERT C. WOOD, formerly in electrical work in New York City, is now in military service, in the Construction Quartermaster's department, Camp Upton, Long Island, New York.

PROF. V. A. C. HENMON, director of the course for the training of teachers at the University of Wisconsin, has been commissioned captain in the aviation section of the Signal Corps of the U. S. Army, to serve as military examining officer on a board to examine applicants for commissions in the aviation service. He will be assigned to active duty about October 15.

CAPT. W. D. PEASLEE is stationed at American Lake, having been assigned to the 316th Regiment of Engineers. At present he is Battalion Adjutant and Regimental Exchange Officer. He is a well known consulting engineer of Portland, Ore., and formerly was with the department of electrical engineering at Oregon Agricultural College.

RUSSELL E. SARD, president of Rathbone Sard Electric Company, Albany, N. Y., who answered the Government's call for men of special training for service in the Navy, received orders to report at Washington on October 15. In response to an inquiry, Mr. Sard is reported as saying: "I am going there to do exactly what they tell me." Mrs. Sard accompanies him to Washington. Affairs of the company will be in the hands of its executive staff during the period of Mr. Sard's absence. He is a leading member of the Albany County Home Defense Committee.

Russell E. Sard.

PROF. E. R. MAURER of the College of Engineering, University of Wisconsin, has direction of the course in æronautics and preliminary training in aviation in that institution, as a phase of war preparation. The number of students who began this course last year will be greatly increased this fall. The prospect is that an aeroplane will be added to the college equipment to afford students an opportunty to study flying machines at close range.

H. L. SPICER, formerly in electrical work at Brooklyn navy yard, is now in service on U. S. Steamship Agamemnon.

CAPTAIN F. M. THRIVES, who served with the French artillery in France up to a few months ago, is now in the United States, at Fort Sill, Oklahoma, giving instruction in artillery practice. He wears the cross of the Legion of Honor.

D. W. BLAKESLEE, electrical engineer, and assistant superintendent of Penn Electrical & Manufacturing Company, has been ordered to report at Washington for duty as first lieutenant in the engineer section, Officers' Reserve Corps.

NAUGLE POLE & TIE COMPANY employees responded promptly to the call to the colors. Six men are now in service, as follows: H. W. Mitchell, formerly manager of the Columbus office, is in the Second Officers' Training Camp at Fort Benjamin Harrison, Ind.; J. B. Naugle, manager of the Minneapolis, Minn., office, is a first class seaman in the U. S. Navy, in training at Great Lakes Training Station, Great Lakes, Ill.; U. C. Zaenglein, manager of the Tulsa, Okla., office is in Company H, 349th Regiment, Camp Sherman, Chillicothe, Ohio; E. W. Rudin, of the Columbus office, is with the Ohio Field Artillery, Camp Sheridan, at Montgomery, Ala.; C. J. Dunlop, of the Kansas City, Mo., office, has enlisted in the U. S. Signal Corps.; F. H. Breidenbach, of the Chicago office, is a carpenter's mate in the U. S. Navy, Great Lakes Training Station, Great Lakes, Ill.

Current Electrical News

WEEKLY RECORD OF CONSTRUCTION ACTIVITIES

EASTERN STATES.

CLAREMONT, N. H.—Claremont Railway & Lighting Company is making rapid progress in the installation of a new girder rail in Pleasant street.

MANCHESTER, N. H.—Manchester Traction, Light & Power Company has filed plans for the construction of a new power station. Contract for erection has been awarded to Whitcomb & Kavanaugh, 6 Beacon street, Boston, Mass. J. Brodie Smith is vice-president and general manager of the company.

NEW BEDFORD, MASS.—J. C. Rhodes Company, 128 Front street, has awarded a contract for the construction of a new one-story power house addition, about 20x41 feet, to cost $10,000. The J. W. Bishop Company, 109 Foster street, Worcester, is the contractor.

WEST SPRINGFIELD, MASS.—Gilbert & Barker Company, Church street, has awarded a contract for the erection of a new one-story power house addition, about 57x95 feet, to the H. Wales Lines Company, 134 State street, Meriden, Conn.

DUNKIRK, N. Y.—Atlas Crucible Steel Company is planning for extensive improvements and additions at its plant, to include the erection of a new transformer station.

HART LOT (Skaneateles Junction), N. Y.—Under franchise of Jordan Electric Light & Power Company this place will be served with electricity and power in a short time.

HOLLEY, N. Y.—Town Council is planning an appropriation of $55,000 for the purchase of the plant of the Brockport-Holley Water Company.

LONG ISLAND CITY, N. Y.—New York & Queens Electric Light & Power Company has acquired property on Mill street, about 25x225 feet, and is reported to be planning for extensions.

NEW YORK, N. Y.—Ice Manufactory Company, 1480 Broadway, is having plans prepared for the erection of a new one-story brick transformer station. Mortensen & Company, 405 Lexington avenue, New York, are the architects.

NEW YORK, N. Y.—New York Edison Company, 130 East Fifteenth street, has had plans prepared for the construction of a new one-story addition, about 25x85 feet, to its power plant at 666-80 First avenue. The structure will cost about $7000. George F. Kiess, 130 East Fifteenth street, is the architect.

PRINCE BAY, S. I., N. Y.—S. S. White Dental Company is planning for improvements in its power station to cost about $11,000.

ROCHESTER, N. Y.—City is planning a bond issue of $75,000 for extensive improvements in its water works.

SYRACUSE, N. Y.—Auburn & Syracuse Electric Railway Company has made application to the Public Service Commission to issue bonds to the extent of $292,000 to provide for existing obligations and improvements.

CAMDEN, N. J.—R. M. Hollingshead has taken out a building permit for the erection of a power house at 112 North Ninth street.

GIBBSTOWN, N. J.—Town Council is planning the early installation of a new electric street-lighting system.

GLOUCESTER, N. J.—Public Service Lighting Company has commenced the installation of a new electric street-lighting system.

HAMMONTON, N. J.—West Jersey & Seashore Railroad is planning for the immediate installation of an electric signalling system at its Bellevue avenue station.

JERSEY CITY, N. J.—Board of Education has awarded contracts for the installation of electric lighting systems in Public Schools Nos. 1, 9, 11, and 20. The new systems, which will replace the present gas illumination, will cost $15,079.

NEWARK, N. J.—Board of Education is planning for the immediate installation of telephones in the Saybrook School and the Hillside Avenue School, Hillside, near Newark, the first mentioned to be tied in with the Elizabeth circuit, and the latter with the Newark circuit.

NEWARK, N. J.—Irvington Manufacturing Company, 124 Coit street, Irvington, near Newark, has taken out a building permit for the construction of a new one-story power house addition to its plant.

NEWARK, N. J.—Public Service Electric Company has been granted permission by the Board of Public Utility Commissioners to issue additional capital stock to the amount of $5,000,000, for extensive improvements in its system.

NEW BRUNSWICK, N. J.—Until Oct. 16, the Board of Commissioners will receive bids for the installation of two new units at the filter plant at the local reservoir. Edward F. Farrington, Director of the Department of Public Affairs.

NEWTON, N. J.—Town Committee is planning for the immediate installation of a new electric street-lighting system.

PERTH AMBOY, N. J.—Lehigh Valley Railroad is making rapid progress in the construction of its new power house at the local yards. George W. Rogers & Company, 29 Broadway, New York, are the contractors.

SUMMIT, N. J.—Town Council is planning for improvements in its fire alarm system.

ALLENTOWN, PA.—Lehigh Valley Transit Company has taken over the interests of the South Bethlehem & Saucon Street Railway, the system of the latter being about six miles long. The lines of the South Bethlehem company run from South Bethlehem to Center Valley, and connect at both ends with the lines of the Transit company.

BRISTOL, PA.—Merchant Shipbuilding Corporation has commenced the construction of a new power house, to be used for works operation.

CHELTENHAM, PA.—Hoffman, DeWitt & McDonough Company, Inc., has awarded a contract for the erection of a new power house, one-story, about 52x60 feet, at its local works. The structure will be of brick and steel. The William Linker Company, 831 Cherry street, Philadelphia, is the contractor.

GREENSBURG, PA. — Westmoreland County officials are having revised plans prepared for the construction of a new two-story power house, about 55x65 feet, to cost about $30,000. Paul Bartholomew, Poulter Building, is the architect.

HALIFAX, PA.—Borough Council has passed an ordinance for a bond issue of $16,000 for the acquirement of the borough water plant.

HALIFAX, PA.—Millersburg Electric Light, Heat & Power Company is making rapid progress in the installation of the new electric street-lighting system.

HAZLETON, PA.—Harwood Electric Company is planning for the construction of new power lines to Conyngham to furnish service for the new street lighting system now being installed.

NORRISTOWN, PA.—Bell Telephone Company has leased a new building now in course of construction, for a period of ten years. It is planned to utilize the structure for increased capacity.

PHILADELPHIA, PA.—Atlantic Refining Company, Twenty-eighth street and Passyunk avenue, will build a new power house addition to cost about $50,000.

PHILADELPHIA, PA. — Philadelphia Felt Company has awarded a contract for the erection of a power house addition to its plant on Frankford Creek.

PHILADELPHIA, PA. — Philadelphia Electric Company, 1000 Chestnut street, has awarded a contract for the construction of a new reinforced concrete, brick and steel power station, about 400 by 400 feet, to cost approximately $2,000,000. Stone & Webster, Tenth and Sansom streets, Philadelphia, are the architects and designing engineers.

POTTSTOWN, PA. — Bell Telephone Company has completed the erection of its new exchange building, and it is planned to occupy as soon as the necessary equipment has been installed.

POTTSTOWN, PA.—Industrial Foundry & Machine Company is planning for the early construction of a new power house for works operation.

READING, PA.—Metropolitan Edison Company is making rapid progress in the installation of its new underground conduit system in Penn Square and various other streets of the city. This system will replace the old overhead wires.

READING, PA.—T. A. Wilson & Company, Second & Washington streets, have filed plans for the erection of a new one-story brick power house, about 25x45 feet. Contract has been awarded to the Beard Construction Company, Reading.

READING, PA.—Metropolitan Edison Company has completed the construction of the new high tension line from its West Reading to the Lebanon power plants and inaugurated operations. The

Business is Good

Our opinion as to future business is most optimistic. We expect when the war ends there will be a readjustment in all lines of business as well as ours, but we believe that this readjustment will not be more serious in the electrical manufacturing field than in any other.—Truman Hibbard, Electric Machinery Company, Minneapolis.

purpose of this new line is to utilize the Lebanon plant as a distributing station in supplying the Lebanon current from Reading, a distance of about 30 miles.

BALTIMORE, MD.—Hess Steel Corporation, Loney's Lane and Pennsylvania Railroad, is planning for the erection of an addition to its electric furnace plant.

BALTIMORE, MD.—By the purchase of a large waterfront tract at Dundalk assurance was given that the proposed new $5,000,000 electric generating plant of the Consolidated Gas, Electric Light & Power Company will be built. The plant will be built by the Consolidated Power Company, a recently incorporated company, which is controlled by the Consolidated Gas, Electric Light & Power Company. The plant will be completed in about 18 months and will have a capacity of about 45,000 kilowatts.

DANVILLE, VA.—Dan River & Riverside Cotton Mills will expend $200,000 for improvements, to include general mill village improvements; electric light, water and sewer system for each dwelling; concrete sidewalks; fencing railway, under passes, etc. Estimated cost of dormitory for women also to be constructed is $100,000.

NORFOLK, VA.—Virginia Railway & Power Company has awarded a contract to J. H. Pierce, Law Building, Norfolk, for the construction of a new one-story substation, about 20x25 feet.

STOVALL, N. C.—S. C. Howard is planning for the erection of a new hydro-electric power plant for the operation of his mill.

ATLANTA, GA. — American Potash Company, which will operate a plant for extracting potash from cyrosite and feldspar, has made arrangements with the Empire Cement & Limestone Company at Portland, Ga., for the use of a portion of its plant, and will use in its operation 205 horsepower in electric motors.

BOWERSVILLE, GA.—Bowersville Gin Company (Franklin district), has abandoned the use of steam for its gins and will drive with two 50-horsepower motors as soon as the line can be completed to the mill.

CLERMONT, FLA.—Clermont Electric Company will buy additional equipment.

JACKSONVILLE, FLA.—City commission is planning an appropriation of $49,000 for extensions in its electric light and power system from the city to the State camp.

NEW SMYRNA, FLA.—Brevard County Telephone Company has been granted 20-year franchise by City Council.

TAMPA, FLA.—Tampa Electric Company has proposed the erection of an extension.

NORTH CENTRAL STATES.

CINCINNATI, O.—It is expected that the first unit of the new river front power house of the Union Gas & Electric Company may be placed in operation some time in December. Every effort is being made to push the work as fast as possible.

DAYTON, O.—S. H. Thompson Manufacturing Company, manufacturing gas for war balloons has increased its capital to allow for improvements and extensions.

FREMONT, O.—Ohio Light & Power Company is completing the construction of a steel tower line connecting Fremont and Fostoria. This is a branch of the American Gas & Electric Company, with headquarters at New York City.

SANDUSKY, O.—The transmission line connecting the plant of the Sandusky Gas & Electric Company and the transmission circuits of the Lake Shore Electric Railway Company is being built. It will tie in these two systems and be of service for emergencies and peak loads.

TOLEDO, O.—Northwestern Ohio Railway & Power Company, with offices in the Ohio building, this city, contemplates installing a 5000-kilowatt turbo-generator in its power house at Port Clinton, O. The final decision on this unit will be determined by the amount of power load added in the near future.

NORTH MANCHESTER, IND.—Eel River Telephone Company has increased its capital from $40,000 to $80,000.

CHICAGO, ILL.—Arcola Electric Company has incorporated with a capital of $50,000. Patrick F. Ludwig, Otto W. Christopher and James W. Taylor are the incorporators.

JOLIET, ILL.—Installation of a new system of street lights which will save the city $8100 a year is under consideration. The lamps are of the nitrogen type, of 250 candlepower and are supplied with refractors which take off the glare while at the same time disseminating the light. In many parts of Chicago and suburban cities the same system is used.

DATES AHEAD.

The Jovian Order. Annual convention, Hotel McAlpin, New York City, October 22-23. Mercury, Ell C. Bennett, Syndicate Trust Building, St. Louis, Mo.

Electrical Committee, National Fire Protection Association. Adjourned annual meeting, New York City, October 23-24. Secretary, Ralph Sweetland, 141 Milk Street, Boston, Mass.

National Electric Light Association, Southeastern Section. Annual convention, Birmingham, Ala., October 24 to 26. Secretary, T. W. Peters, Columbus, Ga.

WILMETTE, ILL.—Council has offered to grant request of Public Service Company of Northern Illinois to build a substation at terminal of the Northwestern Elevated Railroad at Linden avenue, provided the company agrees to erect the building according to the specifications furnished by the village. The plant is to furnish power to the elevated railroad.

HIGHLAND PARK, MICH.—Highland Park has decided to advertise for bids for 66 ornamental iron lamp posts to be installed around the new reservoir.

HOLLY, MICH.—Bonds of $20,000 have been voted to improve the pumping plant so it can be operated by electricity.

BELOIT, WIS.—Arthur J. Sweet, engineer of Milwaukee, has completed plans for a lighting system. Specifications include concrete posts and 250-candlepower single lamp.

LAKE GENEVA, WIS.—Water and light commission contemplate the installation of an electrically operated pumping equipment at the waterworks station. Estimated cost $6200.

MILWAUKEE, WIS.—Park Board is contemplating the installation of a lighting system in Humboldt, Kosciusko, Mitchell and Washington Parks.

NEENAH, WIS.—Contract for the installation of street lights has been let to the Wisconsin Traction, Light, Heat & Power Company.

OSHKOSH, WIS.—Oshkosh Gas & Light Company will erect an addition to the lighting plant here, 90x100 feet. William Wallen is manager of the company and William A. Baehr, 122 South Michigan avenue, Chicago, is engineer.

HUTCHINSON, MINN. — Northern States Power Company's Hutchinson division will furnish electric power for the Farmers' Co-operative Creamery Association building, now being erected at Glencoe, to be ready for occupancy January 1.

MINNEAPOLIS, MINN.—Electric Machinery Company has begun additions to its plant that will double its capacity. About $50,000 will be spent, $28,000 for a new building and crane and the remainder for equipment.

WALKER, MINN.—Cuyuna Range Power Company has been granted franchise for the erection of a transmission line to Walker to furnish electricity at Akely, Nevis, Walker and other towns.

DUBUQUE, IA.—Eastern Iowa Electric Company has been granted franchise to erect transmission lines over county roads to furnish service in Holy Cross, Luxemburg and New Vienna.

STRAWBERRY POINT, IA.—An election will be held to decide the question of selling the municipal electric power plant and granting franchise for the operation of a power plant.

KANSAS CITY, MO.—Kansas City Light & Power Company has bought a site on the Missouri River and will erect a plant with main building 266x600 feet, costing $4,000,000, equipment $10,000,000. Sargent & Lundy, architects, Edison Building, Chicago, prepared plans.

BENNINGTON, KANS.—Markley Company of Minneapolis has been granted a 20-year lease for lighting the residences of Bennington and a 20-year contract for lighting the streets.

HAVEN, KANS.—Haven Electric Light plant has ceased operations.

PRATT, KANS.—Under a plan worked out by W. G. Tagemier, state fish and game warden, electric lights will be installed at the State Fish Hatchery.

PRESTON, KANS.—Preston Mutual Telephone Company will erect a building 30x42 feet.

TOPEKA, KANS.—New bids must be called for the white way extension from Tenth to Eleventh on Kansas avenue. Former bids rejected as being too high, the lowest being $4100.

BLOOMINGTON, NEB.—Town Board is contemplating installation of a dynamo at the waterworks power house to be run by the engine there, which will make power enough to furnish lights during an emergency for the residences and stores.

LINCOLN, NEB.—Platte Valley Telephone Company will issue bonds in the amount of $50,000, to be used in extensions and improvements.

OMAHA, NEB.—Union Power & Light Company has been incorporated with a capital of $2,000,000 by Walter B. Roberts and others.

PENDER, NEB.—Bond issue of $16,500 for an electric lighting system carried.

RED CLOUD, NEB.—Riverton-Inavale Light & Power Company has been incorporated with a capital of $10,000 by J. E. Morris and others.

DOGDEN, N. D.—Dogden Co-operative Farmers' Telephone Company will erect a line 18 miles long, to cost $23,000.

GARRISON, N. D.—Ways and means are under consideration for establishing a lighting plant.

MICHIGAN, N. D.—Contract has been let to J. A. Dinnie & Company, Grand Forks, for the construction of an electric lighting plant and hall.

RYDER, N. D.—Ryder Electric Company has been incorporated with B. A. Dickinson president. The company will install an electric lighting plant to cost $10,000.

SOUTH CENTRAL STATES.

HELLIER, KY.—Greenough Coal Company, Uniontown, Pa., is planning the construction of a new one-story power plant, about 45x70 feet, at the local works.

MURRAY, KY.—City approved a bond issue of $20,000 for the construction of an electric light and power plant.

SHELBYVILLE, KY. — Shelbyville & Frankfort Interurban Railway Company will construct a road 19 miles long. The specifications include five bridges.

ALAMO, TENN.—Election to vote $10,000 bonds for electric lights carried.

FLAT CREEK, TENN.—Flat Creek Mutual Telephone Company. Capital, $7000. J. C. Tune, R. S. Hudson, J. R. Cromler, J. M. Gammil, B. D. Kingrel, J. J. Hix and others.

PORTLAND, TENN.—Portland Electric Company has incorporated with a capital of $10,000, to operate a lighting plant here. The incorporators are R. D. Moore, W. C. Skaggs, George W. Moore, W. C. Austin and George D. Moore.

BIRMINGHAM, ALA. — Birmingham Railway, Light & Power Company proposes the erection of an extension of the Tidewater railway to reach new plant of Tennessee Coal, Iron & Railroad Company, west of Fairfield.

BEAVER CITY, OKLA.—City will issue $8000 bonds to construct electric lighting plant. Bids will be received.

OKLAHOMA, OKLA.—A factory will be erected to manufacture motor cars and trucks.

OKLAHOMA, OKLA. — Sherwin-Williams Paint Company has opened a new warehouse to care for the Oklahoma and Texas Panhandle trade.

SAND SPRINGS, OKLA.—Star Telephone Company. Capital, $20,000. H. A. Davis, J. H. Davis and others.

TISHOMINGO, OKLA.—A movement is under consideration to vote bonds for purchasing, establishing, building and equipping an electric lighting plant or current for furnishing Tishomingo.

WAPANUCKA, OKLA.—About $6000 has been voted for electrical improvements.

FORT STOCKTON, TEX.—Fort Stockton Light & Power Company has installed a new 75-horsepower engine. It is not at all improbable that another engine of the same class will be installed in the near future.

DALLAS, TEX.—Dallas Electric Light & Power Company will construct a high tension transmission system to aviation camp, a distance of six miles; estimated cost $25,000.

HOUSTON, TEX.—Houston & Texas Central Railway will construct a brick and concrete interlocking signal tower at Bonner's point at a cost of $16,000. The tower is to be 24 feet high from the top of which a watchman will manipulate a semaphore system. Address E. E. Worthington, Signal Engine, Houston.

WESTERN STATES.

BUTTE, MONT.—A lighting district is to be established on South Montana street.

BUTTE, MONT.—Montana Power Company is rapidly developing into the most important industrial corporation in Montana. With the completion of the Holter hydroelectric plant, 30 miles north of Helena, the company has added another large unit to its power facilities. Construction has been completed but generation of power will not begin until November 1.

GREAT FALLS, MONT. — Electrical Service Company recently opened for business here. The new company solicits only repair work along electrical lines and is catering particularly to the automobile trade. C. A. Luckett and E. W. Kimberk are partners in the firm.

MALTA, MONT.—Contract for an electric lighting system has been let to George W. Kemper, Minot, N. D., for $39,900.

SALT LAKE CITY, UTAH.—Electrification of the Denver & Rio Grande between Salt Lake City and Helper will be undertaken soon after the merging of the road with the Missouri Pacific and the Western Pacific. Engineers representing the General Electric Company recently completed a survey of the road and it is stated that the General Electric will offer to finance the electrification.

BOISE, IDAHO.—Idaho Electric Company, which has heretofore been a Salt Lake concern, has now become a strictly Boise (Idaho) company, a group of the employes who have been connected with the store for several years having purchased the Salt Lake interests. S. Gwaitney is president of the new company and L. R. Walker, secretary. The firm has been transacting business in Boise for twelve years.

SILVER CITY, IDA.—It is reported that the Idaho Power Company plans the immediate extension of its transmission lines to Deming.

SEATTLE, WASH.—American Nitrogen Products Company has started active developments of its power project in Snohomish County, where the company will develop power for the nitrogen products plant along lines established by the same company at La Grange.

SEATTLE, WASH.—Burton R. Stare, of the Northwestern Supply Company, was low bidder for the eight one-man cars to be used on the Nickerson street line of the Seattle municipal railway at $5735 each.

SEATTLE, WASH.—Council has awarded $390,000 electric light bonds to the Dexter-Horton Trust & Savings Bank on a basis of five per cent interest at the rate of 92.54.

SEATTLE, WASH.—Council has voted for the plan to extend the city car lines in connecting up the Lake Burien and Division A lines, making it possible to compete for the traffic emanating at the Seattle shipyards. The plan proposes the construction of an elevated railway on Washington street, Railroad avenue, Whatcom avenue and Spokane street and extending from First avenue South to the West Waterway at an estimated cost of $350,000.

SEATTLE, WASH.—While the plan of the city council to purchase a completed hydroelectric plant for the lighting department has not been abandoned, bids will not be opened on October 5 as called for and no date has been fixed for this purpose. Plans for a complete hydroelectric plant were completed nearly a year ago and the council authorized a utility bond issue of $3,000,000 to cover the cost of such a plant.

SEATTLE, WASH.—Kilbourne & Clark Manufacturing Company, maker of wireless apparatus, is now moving its plant from the Poulson building to its new location on the East Waterway. The new home of the concern is a concrete building recently purchased. It is the intention to increase the force to 350 or 400 men. The number employed at present is 125.

KASLO, B. C., CANADA.—The city electric system will be improved at a cost of $2000.

PRINCE RUPERT, B. C., CANADA.—The question of power available at Falls and Thulme rivers is being investigated by the city. The Falls river site, where 12,000 horsepower could be developed at a cost of $1,500,000, is favored.

GOLD HILL, ORE.—City contemplates the installation of a $25,000 power plant to operate the city water plant.

ALHAMBRA, CAL.—Pacific Electric Railway officials are preparing to extend the service lines from the terminus at Glendora to Lone Hill station, to fill the gap between Glendora and San Dimas and to construct a spur line to the Glendora Citrus Association's packing house.

LOS ANGELES, CAL.—C. F. Mason, commercial superintendent for Southern California Telephone Company has announced that the company will spend $200,000 to facilitate the consolidation of the Home and Sunset telephone systems in Los Angeles.

LOS ANGELES, CAL.—Southern California Edison Company will spend $2,000,000 in the erection of a 12,500-horsepower plant at Big Creek.

RICHMOND, CAL. — Western States Gas & Electric Company has received application from the newly incorporated city of El Cerrito for electric service for street lighting purposes and an investigation is now under way.

SAN DIEGO, CAL.—Board of Supervisors is receiving sealed bids for electric current for 55 600-candlepower series Mazda lamps in the Imperial Beach Highway Lighting District.

SAN DIEGO, CAL.—San Diego Consolidated Gas & Electric Company has been awarded a 50-year franchise for the installation of electric power service throughout the county. The company paid $100 for the franchise and San Diego County will receive three per cent of the gross profits of the company, beginning five years after the contract is entered into.

Electrical Patents Issued October 2, 1917

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,241,492. Dynamo Suspension. W. F. Bouche, Buffalo, N. Y., assignor to Gould Coupler Co. For use on railway cars.

1,241,493. Bearing. A. L. Groomall, & E. G. Tidlund, assignors to Westinghouse Electric & Mfg. Co. For a split frame railway motor.

1,241,496. Thermo-Couple. L. W. Chubb, assignor to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Structure adapted to make intimate engagement with surface whose temperature is to be determined.

1,241,497. Bond-Wire Connector. W. W. Coleman, New York, N. Y. For connecting track rails.

1,241,498. Electric Locomotive. J. Le C. Davis, deceased, assignor to Westinghouse Electric & Mfg. Co. Mounting of motor in frame.

1,241,499. Polyphase Electric Furnace. J. L. Dixon, Detroit, Mich. Regulation of electrodes. (See cut.)

1,241,500. Locomotive. G. M. Eaton, assignor to Westinghouse Electric & Mfg. Co. Frame structure.

1,241,503. Dynamo-Electric Machine. A. B. Field, assignor to Westinghouse Electric & Mfg. Co. Field structure, with special view to ventilation and prevention of eddy currents.

1,241,505. Multiphase Rectifying System. C. LeG. Fortesque, assignor to Westinghouse Electric & Mfg. Co. Employs vapor rectifiers in connection with two three-phase systems.

1,241,507. Control System. A. J. Hall, assignor to Westinghouse Electric & Mfg. Co. For a plurality of polyphase induction motors.

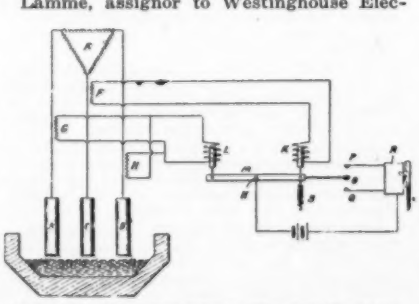
1,241,510. Controller. E. A. Hanff, assignor to Westinghouse Electric & Mfg. Co. Structure operated by oscillating lever.

1,241,512. Adjusting Incandescent Lamps. C. O. Harrington, assignor to Union Switch & Signal Co., Swissvale, Pa. Means for adjusting lamp so that filament is in a certain position with relation to base.

1,241,515. Arc-Lamp. A Huttar, assignor to Westinghouse Electric & Mfg. Co. Structure of chambers for enclosing arc and circulating gases. (See cut.)

1,241,520. Electric-Light-Control System. J. H. Jordan, Scranton, Pa. Time switch mechanism.

1,241,523. Control System. B. G. Lamme, assignor to Westinghouse Electric & Mfg. Co. For plurality of induction motors.



No. 1,241,499.—Polyphase Electric Furnace.

1,241,528. Insulator. P. M. Lincoln, assignor to Westinghouse Electric & Mfg. Co. Suspension.

1,241,533 and 1,241,534. Circuit-Interrupter. J. B. MacNeill, assignor to Westinghouse Electric & Mfg. Co. First patent: details of electromagnetically operated switch. Second patent: has two breaks in series with a reactor about one.

1,241,549. Limiting Reactance-Coil. J. F. Peters, assignor to Westinghouse Electric & Mfg. Co. Arrangement of winding.

1,241,554. Electromagnetic Device. K. C. Randall, assignor to Westinghouse Electric & Mfg. Co. For operation from a single phase source.

1,241,556. Electrical Connector. E. E. Rose & O. A. Colby, assignors to Westinghouse Electric & Mfg. Co. Details of structure for connecting with curling irons and the like.

1,241,558. Trolley. W. Schaake, assignor to Westinghouse Electric & Mfg. Co. Pantograph structure.

1,241,559. Commutator. H. M. Scheibe, assignor to Westinghouse Electric & Mfg. Co. Desk type structure.

1,241,560, 1,241,561 and 1,241,562. Spark-Plug. A. Schmidt, assignor to Champion Ignition Co., Flint, Mich. Structural details.

1,241,565. Method of and Apparatus for Radiosignaling. H. Shoemaker, assignor to Marconi Wireless Telegraph Co. of America, New York, N. Y. Wireless receiving apparatus.

1,241,566, 1,241,567, 1,241,568 and 1,241,569. Control System. K. A. Simmon and A. J. Hall, assignors to Westinghouse Electric & Mfg. Co. First and second patents: systems for controlling alternating motors by liquid rheostats. Third patent: master controller system of motor acceleration. Fourth patent: interlocked air brake and railway motor control.

1,241,571. Electrical Protective Device. B. H. Smith, assignor to Westinghouse Electric & Mfg. Co. Arrangement of relays and circuit breakers in a polyphase circuit.

1,241,574. Regulating Apparatus for Electric Furnaces. W. Sykes, assignor

to Westinghouse Electric & Mfg. Co. For varying the electrode position.

1,241,578. **Electric Heating Apparatus.** F. Thornton, Jr., assignor to Westinghouse Electric & Mfg. Co. Insulating fragments are bound together, a conductor placed thereon and the binder removed.

1,241,580. **Automatic Cut-out for Switches.** A. R. Trillitsch, Chicago, Ill. Electromagnetic trip is applied to knife switch without interfering with its manual operation.

1,241,585. **Lighting System.** A. E. Twiddy and J. Stally, Seven-Oaks, England. For operation from a high tension ignition magneto.

1,241,592. **Switch for Electric Circuits.** R. Wikander, assignor to Westinghouse Electric & Mfg. Co. Structure in which closure by an electromagnet is governed by excess current.

1,241,599. **Oscillating Fan-Motor.** C. Aalborg, assignor to Westinghouse Electric & Mfg. Co. Oscillating mechanism may be uncoupled and the fan held stationary.

1,241,600. **Oscillating Fan.** C. Aalborg, assignor to Westinghouse Electric & Mfg. Co. Manner of operating oscillating vanes.

1,241,601. **Trolley.** C. Aalborg, assignor to Westinghouse Electric & Mfg. Co. Pantograph structure.

1,241,608. **Crossing-Signal for Railroads.** K. B. Coleman, Scottsburg, Va., assignor one-half to J. E. Green, Jr., Clover, Va. Structure of track instrument.

1,241,627. **Terminal for Electrical Appliances.** F. J. Hadfield, Oulton Broad, near Lowestoft, England. Binding post with spring conductor grip.

1,241,655. **Electric-Arc Furnace.** O. J. S. Platou, assignor to Norsk Hudro-elektrisk Kvaelstofaktieselskab, Christiania, Norway. Of the type having a magnetically spread flame.

1,241,659. **Electric Portable Grinder.** E. Ritz, Jr., assignor to Hisey-Wolf Machine Co., Cincinnati, Ohio. Relates to driving connections of grinding wheel.

1,241,672. **Automatic Scale.** W. S. Smith, assignor to L. R. Drake, Columbus, O. Steel yard scale has motor-driven weight controlled by tilting of beam.

1,241,712. **Railway-Track Trip.** J. Culton, Denver, Colo. Includes an electromagnetically controlled trip rail.

1,241,731. **Telephone-Mouthpiece.** J. F. Havlena, Detroit, Mich. Details of construction.

1,241,734. **Spark-Plug.** H. H. Hoff and F. E. Talleur, St. Louis, Mo. Structural details.

1,241,737. **Connector for Batteries.** C. B. Johnson, assignor one-third to P. R. Ingram and one-third to J. E. Cole, Norfolk, Va. Structure of wire clip.

1,241,748. **Monorail Traction-Wheel.** R. A. McClure, assignor to Universal Rwy. Co., Seattle, Wash. Includes a propelling motor.

1,241,751. **Spark-Plug Attachment.** N. R. Michael, Mainville, Pa. Manner of mounting a transparent casing, containing a spark gap, on a plug.

1,241,771. **Portable Indicator.** E. E. Schram, Detroit, Mich. Combination of flash light and rotatable exhibitor.

1,241,782. **Warmer for Motor-Cars.** J. G. Tharp, Indianola, Iowa. Manner of mounting and connecting electric heater on steering wheel.

1,241,809. **Cable Splice.** E. W. Beardsley, San Francisco, and P. W. Ham, Oakland, Cal. For connecting a pair of lead and wire armor covered cable ends.

1,241,851. **Electric-Lamp-Socket Shell.** L. Lle, Toronto, Ontario, Canada. Manner of connecting shell and cap.

1,241,873. **Block-Signaling System.** R. C. Millard, Atlanta, Ga. Arrangement of circuits for controlling cab signals and brake valve.

1,241,874. **Lamp.** H. Miller and F. Mueller, Irvington, N. J., assignors of one-third to R. C. Hunter, Newark, N. J. For displaying multi-colored lights.

1,241,888. **Alarm System.** J. H. Safford, Brooklyn, N. Y. Gravity controlled contact in chest to give alarm on its movement.

1,241,898. **Ground Clamp.** H. B. Andrews, W. H. Hart. For connecting with pipes.

1,241,899. **Welding-Electrode and Process of Welding.** P. A. E. Armstrong, assignor to W. L. Clark and A. H. Adams, New York, N. Y. Electrode for depositing metal has a coating to form a slag to prevent oxidation of deposited molten metal and an outer coating of more highly refractory material.

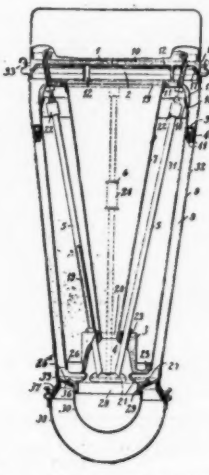
1,241,900. **Process for Electric Welding.** P. A. E. Armstrong, assignor to W. L. Clark and A. H. Adams. Metal deposited from above electrode is cooled with water. Especially for depositing manganese steel upon manganese steel.

1,241,904—**Direction Indicator for Automobiles.** O. C. Baumgart, Atascadero, Cal., assignor one-half to O. M. Elliott, Los Angeles, Cal. Has an opaque screen with translucent indicia normally invisible from front of screen.

1,241,908. **Railway Lighting Apparatus.** J. Bijur, assignor to Safety Car Heating & Lighting Co., New York, N. Y. Axle-driven system.

1,241,925. **Telephone-Exchange System.** H. P. Clausen, assignor to Western Electric Co. Manual.

1,241,926. **Insulation of Condensers for Telephone-Circuits.** C. Cordes, Magdeburg, Germany. Is obtained from castor



No. 1,241,515.—Arc Lamp.

oil by treatment with hydrogen in the presence of finely divided catalytic material with heat.

1,241,927. **Block-Signal.** D. F. Crawford, Pittsburgh, Pa. Relates to semaphores and operating circuits.

1,241,929. **Insulator.** W. A. Dade and R. E. Morgan, Orlando, Fla. Tieless knob.

1,241,934. **Theft Preventing and Signaling Device.** S. A. Deanes, West Point, Miss. For automobiles.

1,241,963. **Electrical Means for Locating Concealed Pipes.** E. H. Grove, assignor one-eighth to A. Marks, one-eighth to R. A. Kern, one-eighth to J. F. Kreamer, and one-eighth to W. F. Sullivan, Washington, D. C. Arrangement of exploring coil and telephone receiver in a portable instrument.

1,241,966. **Zinc-Extraction Process.** H. R. Hanley, assignor to Bully Hill Copper Mining & Smelting Co. For extracting zinc from material containing arsenic, antimony, selenium, tellurium, bismuth or the like; includes electrolytic treatment.

1,241,967. **Electrolytic Apparatus.** H. R. Hanley, Winthrop, Cal., assignor to Bully Hill Copper Mining & Smelting Co. Relates to aerating arrangements.

1,241,990. **Engine-Starting Device.** C. F. Kettering and W. A. Chryst, assignors to Dayton Engineering Laboratories Co., Dayton, Ohio. Relates to driving connections and resistance starting of the motor by brush shifting which is interlocked with the aforesaid connections.

1,241,993. **Electric-Revolution-Meter for Internal Combustion Engines.** J. Kirby, New York, N. Y. Operated from the ignition circuit.

1,241,998. **Prepayment Coil Device.** J. W. Lattig and C. L. Goodrum, assignors to Western Electric Co. For telephone systems.

1,242,003. **Electrical Valve.** H. Lewis, assignor to A. J. Lloyd, Pittsburgh, Pa. Solenoid operated structure.

1,242,008 and 1,242,010. **Telephone-Exchange System.** A. E. Lundell, assignor to Western Electric Co. First patent: manual. Second patent: a selector switch has interlocked manual operating and releasing means.

1,242,009. **Impulse-Control System.** A. E. Lundell, assignor to Western Electric Co. Special control of selector switch by impulse sender.

1,242,013. **Lock Switch.** F. E. Matteson, Los Angeles, Cal. Structural details.

1,242,014. **Lightning-Arrester.** D. T. May, assignor to Western Electric Co. Vacuum device.

1,242,022. **Transmitter-Mouthpiece.** E. C. G. Mueller, assignor to Western Electric Co. Structural details.

1,242,038. **Vibrating Self-Interrupter for Electric Bells, etc.** W. E. R. Rademaker, Hoboken, N. J. Structural details.

1,242,048. **Support for Suspended Conductors.** H. Schaefer, Astoria, N. Y. For supporting trolley from span wire.

1,242,051. **Combined Telegraph-Key and Spring-Jack Switch.** C. B. Scollard, Seattle, Wash. Details of construction.

REISSUES.

14,370. **Dynamo-Electric Machine.** J. LeC. Davis, deceased, by Westinghouse Electric & Mfg. Co., assignees. Relates to ventilation of railway motors.

14,372. **Electric Switch.** W. H. Farmer, assignor one-third to L. A. Dunton, Boothbay Harbor, Me. Structure of device having one-piece insulating body and rotary movable member.

14,373. **Ignition-Dynamo.** C. T. Mason, assignor to Splitdorf Electrical Co., Newark, N. J. Structure of magneto.

Patents Expired.

The following United States electrical patents expired on October 9, 1917:

659,236. Process of Making Sulphuric Acid. A. C. Johnson, Baltimore, Md.

659,244. Circuit Controller. A. Lungen, New York, N. Y.

659,268. Glower-heating Apparatus for Electric Lamps. J. Van Vleck and W. N. Stevens, New York, N. Y.

659,269. Annunciator for Telephone Exchanges. B. Waller, Detroit, Mich.

659,338. Process of Extracting Zinc and Copper from Their Ores. C. G. Collins, New York, N. Y.

659,355. Trolley Finder and Guard. H. C. Williams, Pasadena, Cal.

659,357. Apparatus for Locating Faults in Electric Circuits. W. E. Athearn, New York, N. Y.

659,389. Electric Meter. T. A. Edison, Llewellyn Park, N. J.

659,409. Electric Bipolar Dilator. C. L. Mosher, Chatham, N. Y.

659,417: Self-adjusting Circuit-breaker for Electrical Welding Machines. J. C. Perry, Clinton, Mass.

659,433. Perforator for Preparing Telegraphic Messages. C. L. Buckingham and E. Germann, New York, N. Y.

659,454. Switch-operating Mechanism. F. A. Ruff, Detroit, Mich.

659,467. Electrical Illuminated Button. W. A. Church, Pittsburgh, Pa.

659,479. Electric Programme Clock. H. F. Jordan, Chicago, Ill.

659,506. Magnetic Regulator for Galvanometers. J. J. Bradley, Newark, and L. M. Pigmolet, Orange, N. J.

659,533. Electrically Controlled Coin-feeding Appliance for Vending Machines. R. Kann, Jena, Germany.

659,539. Supporting Device for Electric Motors. C. A. Lindstrom, Chicago, Ill.

659,544. Telegraph System. F. D. Pearne, Davenport, Iowa.

659,550. Electric Railway. J. D. Robertson, LaSalle, Ill.

659,559. Lightning Arrester. C. M. Taylor, Georgetown, Ky.

659,588. Telephone - switchboard Annunciator and Jack. C. T. Mason, Sumter, S. C.

659,605. Electric Thermostat. L. H. Des Isles, Cambridge, Mass.

659,631. Device for Removing and Replacing Incandescent Lamps. R. Croteau and R. J. Messier, Denver, Colo.

Financial News and Comment

Public Utility Dividends.

American Light and Traction Company declared the regular quarterly dividends of 1½% on the preferred and 2½% in cash on the common, also 2½% in stock on the common, payable November 1 to stock of record October 10. Books reopen October 29.

Edison Electric Illuminating Company of Boston declared the regular quarterly dividend of 3%, payable November 1, to stock of record October 15.

West Penn Power Company declared the regular quarterly dividend of 1¾% on the preferred stock, payable November 1 to stock of record October 20.

Western Power Company of Canada is reported as follows: August operating revenues were $37,338, an increase of 16.85% over same month last year, and net earnings of $25,827, an increase of 6.64%. Net earnings for the year 1917 to date were $212,731, compared with $161,-419 in 1916 and the twelve months ended August 31, 1917, amounted to $330,101, an increase of 31.37% over the corresponding previous twelve months.

The Board of Directors of the Western States Gas & Electric Company has declared the regular quarterly dividend of 1¾% on the preferred stock of the Company, payable October 15 to stockholders of record September 29.

Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½% on the preferred stock, payable October 31 to stock of record October 20.

Nevada California Electric Corporation declared the regular quarterly dividend of 1½% on the preferred stock, payable Oct. 30 to stock of record Sept. 30.

The Public Service Corporation of Northern Illinois declared the regular quarterly dividends of 1½% on the preferred and 1¾% on the common stocks, both payable November 1 to stock of record October 15.

South Carolina Light, Power & Railways Company declared a quarterly dividend of 1½% on the preferred stock, payable October 1 to stock of record September 20.

Georgia Light, Power & Railways declared a quarterly dividend of 1½% on the preferred stock, payable October 1 to stock of record September 24.

Western Power Corporation declared the quarterly dividend of 1% on preferred stock, payable October 15 to stock of record September 30. Accumulated dividends amount to 9½%.

A dividend of $1.18 was also declared on the preferred stock of the Western Power Company of New Jersey, a subsidiary. This compares with $1.30 paid the last quarter.

Consumers' Electric Light & Power Company has declared the regular quarterly dividend of 1¾% on the preferred stock, payable September 30. Books close September 8 and reopen October 1.

Pacific Gas & Electric Company directors met September 29 to declare the regular quarterly dividend of $1.25 upon the common stock, payable October 15 to stock of record September 29.

Detroit United Railways Company declared a dividend of $2 on the capital stock at the rate of $8 per annum, payable December 1 to stock of record November 15. This is the same amount as was declared in the two previous quarters.

Copper Market.

When the War Industries Board fixed the price of copper at 23.5 cents, it established terms for transactions between the copper producers and the Government, but left an element of uncertainty in domestic trade circles. There exists a lack of explicitness when it comes to rules governing transactions between consumers on the one hand and dealers and producers on the other. The truth of this is affirmed by an inactive market. Efforts are being made to facilitate the necessary movement of copper from the producer to the domestic consumer. Action along this line has taken the form of a committee of copper consumers, which is to advise with the War Industries Board as to the distribution of copper among manufacturers. The committee is composed of the following representatives of heavy consumers, and is to hold a meeting about October 15:

C. F. Brooker (Chairman), American Brass Company; Barton Haselton, Rome Brass & Copper Company; W. F. Banker, General Electric Company; L. H. Jones, Detroit Copper & Brass Rolling Mill Company; G. P. Miller, Bridgeport Brass Company; A. L. Salt, Western Electric Company; Carl Roebling, J. A. Roebling's Son Company; G. A. Cook, Taunton-New Bedford Copper Company; D. M. Brady, Brady Brass Company; M. H. Howard (Secretary) National Conduit & Cable Company.

Contracts for future delivery to consumers are said to average 27 cents a pound, and the status of such contracts is still undetermined, as to how they are to be affected by the Government price. Meantime, the larger brokers are reported as asking 26 cents for deliveries after January 1.

Costs of producing copper, which are assumed to form the basis for stabilizing prices, present a wide range of figures, as shown by the following table, which gives the output and costs of 36 producing companies for 1916:

Company:	Pounds produced in 1916.	Cost per lb.
Kennecott Cop. Corp.	108,372,783	†5.10c
United Verde Extension Mining Co.	36,402,972	†6.4
Utah Cop. Co.	187,531,824	6.95
Champion Cop. Co.	33,601,136	7.8
Braden Cop. Co.	42,153,270	*8.03
Chino Cop. Co.	72,319,508	8.706
Shat.-Ariz. Cop. Co.	18,161,763	8.716
Mohawk Mining Co.	18,468,100	8.85
Cal. & Ariz. Min. Co.	74,898,788	9.04
Inspir. Con. Cop. Co.	120,772,637	9.294
Nev. Con. Cop. Co.	90,735,287	9.44
Miami Cop. Co.	53,518,331	9.522
Ray Con. Cop. Co.	74,983,540	10.267
Allouez Mining Co.	10,219,290	10.47
Magma Cop. Co.	8,473,580	10.803
Baltic Mining Co.	12,425,804	10.85
Trimountain	8,720,558	11.1
White Pine Cop. Co.	4,207,449	11.22
Greene-Can. Cop. Co.	62,250,067	11.352
Ahmeek Mining Co.	24,142,158	11.47
Cal. & Hec. Mining Co.	76,762,240	11.63
Old Dom. Cop. Min. & Smelt. Co.	17,654,643	11.69
Osceola Con. Min. Co.	19,586,501	11.69
Chile Cop. Co.	41,305,476	*11.76
Quincy Mining Co.	21,065,612	12.642
Centennial Cop. Min. Co.	2,367,400	13.44
Superior Cop. Co.	3,034,656	13.78
Tenn. Cop. & Chem. Co.	9,404,295	14.36
Isle Royale Cop. Co.	12,412,111	15.32
Mass Con. Min. Co.	4,752,588	15.37
North Butte Min. Co.	24,498,181	†15.57
East Butte Min. Co.	18,340,713	†16.8
Shannon Cop. Co.	9,364,968	18.416
Victoria Cop. Co.	1,661,832	19
La Salle Cop. Co.	1,380,352	19.96
Franklin Mining Co.	3,116,566	20.22
Total	949,709,359	

* Cost at the plant. Owing to high insurance, freight rates, etc., the cost delivered was much higher. † Estimated.

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Oct. 2.	Bid Oct. 9.
Adirondack Electric Power of Glens Falls, common	..	13	13
Adirondack Electric Power of Glens Falls, preferred	6	62	62
American Gas & Electric of New York, common	10+extra	103	103
American Gas & Electric of New York, preferred	6	45	45
American Light & Traction of New York, common	..	264	245
American Light & Traction of New York, preferred	6	103	101
American Power & Light of New York, common	4	60	60
American Power & Light of New York, preferred	6	82	82
American Public Utilities of Grand Rapids, common	..	28	28
American Public Utilities of Grand Rapids, preferred	6	61	60
American Telephone & Telegraph of New York	..	115¾	114
American Water Works & Elec. of New York, common	..	5	4½
American Water Works & Elec. of New York, particip.	7	13	11
American Water Works & Elec. of New York, first preferred	..	62	63
Appalachian Power of Bluefield, common	..	3	3
Appalachian Power of Bluefield, preferred	7	25	25
Cities Service of New York, common	+extra	227	222
Cities Service of New York, preferred	6	81¼	80¾
Commonwealth Edison of Chicago	8	118	117½
Comm. Power, Railway & Light of Jackson, common	4	43	43
Comm. Power, Railway & Light of Jackson, preferred	6	74	74
Federal Light & Traction of New York, common	..	10	10
Federal Light & Traction of New York, preferred	..	45	45
Illinois Northern Utilities of Dixon	6	77	75
Middle West Utilities of Chicago, common	2+2 extra	39	38
Middle West Utilities of Chicago, preferred	6	67	67
Northern States Power of Chicago, common	ex div. 7	74	74
Northern States Power of Chicago, preferred	ex div. 7	93	93
Pacific Gas & Electric of San Francisco, common	5	41	40½
Pacific Gas & Electric of San Francisco, preferred	6	86	86
Public Service of Northern Illinois, Chicago, common	7	87	87
Public Service of Northern Illinois, Chicago, preferred	6	94	93
Republic Railway & Light of Youngstown, common	4	29	29
Republic Railway & Light of Youngstown, preferred	6	64	64
Standard Gas & Electric of Chicago, common	..	7	7
Standard Gas & Electric of Chicago, preferred	6	30	29
Tennessee Railway, Light & Power of Chattanooga, common	..	4	3½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	22	23
United Light & Railways of Grand Rapids, common	4	37	33
United Light & Railways of Grand Rapids, preferred	6	67	67
Western Power of San Francisco, common	..	11¾	11¾
Western Power of San Francisco, preferred	6	50	50
Western Union Telegraph of New York	extra	88	86
Industrials—			
Electric Storage of Philadelphia, common	4	56	55½
General Electric of Schenectady	8	140½	137
National Carbon of Cleveland, common	8	75	*76¼
National Carbon of Cleveland, preferred	..	*130¾	*130¾
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	46	43¾
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	63	60

*Last sale.